FINAL SYNOPSIS OF THE PH.D. THESIS

"IMPACT OF YOGA PRACTICES ON PSYCHO-IMMUNOLOGICAL CHANGES AMONG YOUTHS; A COMPARATIVE STUDY"

SUBMITTED TO THE MANGALORE UNIVERSITY

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY IN

YOGIC SCIENCE

by

Mr. PUNITKUMAR BASAVARAJ NAYAK

Under the supervision of

Dr. K. KRISHNA SHARMA

Retired Professor

DEPARTMENT OF HUMAN CONSCIOUSNESS & YOGIC SCIENCES

MANGALORE UNIVERSITY, MANGALAGANGOTHRI-574199

KARNATAKA, INDIA

2025

Name of the Research Scholar: **Mr. Punitkumar Basavaraj Nayak**

Present Address: Research Scholar

Department of Human Consciousness &

Yogic Sciences Mangalore University,

Mangalagangothri-574199.

Name of the Research Guide: **Dr. K. Krishna Sharma**

Retired Professor

Department of Human Consciousness &

Yogic Sciences Mangalore University,

Mangalagangothri-574199.

Title of the Thesis: "Impact of Yoga Practices on Psycho-Immunological Changes Among Youths; A Comparative Study"

Date of Registration: 20.12.2021

Register No: 211791340104

Official Memorandum No: MU/EXB/Ph.D./CR.77/Yoga/2022-23/E.25

Dated: 05.09.2023

CHAPTER – I
INTRODUCTION

Introduction

Modern youth are increasingly exposed to stress due to academic pressure, social expectations, and digital overload, leading to negative psychological and immune outcomes. Psycho-immunology, a field exploring the mind-immune connection, has shown that emotional states significantly influence immune responses (Soliman et al., 2014). Groundbreaking work by Ader & Cohen (1975) confirmed this link, establishing the foundation for psychoneuroimmunology (PNI).

Yoga, an ancient Indian practice involving postures (asanas), breathing (pranayama), and meditation, has gained attention for promoting both psychological and physiological well-being. It is effective in reducing stress, regulating the HPA axis, enhancing heart rate variability, and modulating immune function (Pascoe et al., 2017; Gautam et al., 2024). Yoga also supports genomic stability and slows biological aging through epigenetic effects.

Recent studies have emphasized the need for strengthening immunity in adolescents, especially amid declining global vaccination rates (WHO, 2023). As adolescence is a critical stage of immune system development, interventions promoting immune resilience and emotional stability are crucial (Smith et al., 2020; Jones et al., 2019).

The concept of psycho-immunity mental resilience against stress, fear, and negative emotions adds a psychological layer to immunity. Bhardwaj & Agrawal (2015) proposed five core components of psycho-immunity: self-esteem, adjustment, emotional maturity, positive memories, and stress tolerance.

Yoga, with its holistic approach, addresses both psychological and immunological needs, making it a promising tool for youth mental and physical health (Gupta et al., 2022; Singh, 2013).

The chapter highlights the **growing mental health crisis** among youth, with increasing rates of stress, anxiety, depression, and vulnerability to immune dysfunction due to developmental, social, academic, and digital pressures. It presents key factors affecting youth mental health—such as socioeconomic challenges, family dynamics, academic pressure, social media use, and substance abuse emphasizing the need for holistic interventions.

Immune health in adolescents is also explored, underscoring the role of cytokines, vaccination, and general well-being in preventing illness. The rise in vaccine-preventable diseases, especially after the COVID-19 pandemic, highlights the urgent need to strengthen youth immunity through sustainable lifestyle approaches.

Yoga is then introduced as a **holistic mind-body practice** rooted in ancient Indian wisdom. Scientific evidence supports its benefits in regulating stress responses, enhancing immune modulation, improving emotional regulation, and balancing the autonomic nervous system. Concepts like **psycho-immunity** the mental defense system against emotional distress are also discussed.

Need for the Study

In today's high-stress environment, youth face increased mental strain and declining immune health. The interplay between stress and immune suppression highlights the urgent need for integrative, preventive approaches. Yoga offers a scientifically backed, natural method to enhance emotional resilience and immune strength.

This study seeks to examine the long-term effects of yoga practices on psycho-immunological variables among youth. It aims to provide empirical evidence to support yoga's integration into health, education, and wellness initiatives, offering a balanced lifestyle approach that strengthens both mind and body.

CHAPTER II
YOGA AND PSYCHOIMMUNOLOGY

In today's fast-paced world, youth are increasingly burdened by stress, leading to adverse psychological and immunological outcomes. The field of psychoimmunology, which examines the link between psychological states and immune function, has gained prominence as researchers seek holistic approaches to health. Early contributions by Solomon (1964), Ader and Cohen (1975), and subsequent scholars established how emotions and behavior influence immune responses.

Adolescents, facing academic pressure, social media influence, and emotional turbulence, are especially vulnerable to both mental health challenges and weakened immunity. Stress, anxiety, and depression not only impact psychological health but also impair immune resilience, increasing susceptibility to infections and chronic diseases (Smith et al., 2020; Jones et al., 2019).

Yoga, an ancient Indian discipline combining physical postures, breathing techniques, and meditation, has demonstrated significant potential in improving both mental and physical health. Scientifically, yoga modulates the hypothalamic-pituitary-adrenal (HPA) axis, reduces inflammation, and improves autonomic balance and heart rate variability (Gautam et al., 2024). It also positively influences the epigenome, thus supporting immune function and cellular health.

Given the current decline in global youth immunization and a rise in stress-related disorders, there is an urgent need to explore integrative approaches like yoga. The WHO emphasizes psychological well-being as essential to personal and societal health (WHO, 2014), aligning with yoga's principles of mental clarity and inner balance.

This study focuses on the **psycho-immunological effects of yoga on youth**, aiming to evaluate changes in psychological well-being and immune markers following a structured yoga intervention. The findings may inform school-based wellness programs, youth therapy modules, and public health policies by offering evidence-based support for yoga as a non-pharmacological, holistic solution.

CHAPTER III
REVIEW OF LITERATURE

This chapter presents a comprehensive review of existing research focused on the interconnected effects of yoga on psychological health and immune function, framed within the emerging discipline of psychoimmunology. The literature reveals that psychological factors such as chronic stress, depression, and anxiety have a significant impact on immune system functioning. This bidirectional relationship indicates that while poor mental health can impair immunity, weakened immunity may also worsen psychological conditions. Yoga, as an integrative mind-body practice rooted in ancient Indian traditions, has been increasingly studied for its ability to alleviate psychological distress and enhance immune responses.

Scientific studies have demonstrated that regular yoga practice reduces anxiety, depression, and perceived stress while promoting emotional regulation and cognitive clarity. These benefits are attributed to yoga's influence on the autonomic nervous system—particularly through increased parasympathetic activity and suppression of the stress-related sympathetic response. Controlled breathing techniques and mindfulness, central components of yoga, contribute to lower cortisol levels, improved heart rate variability, and enhanced mood and resilience.

On the physiological front, yoga has shown potential in modulating immune responses. It decreases inflammatory markers such as IL-6, TNF-α, and CRP, while enhancing the activity of natural killer cells and increasing levels of immunoglobulin A (IgA). Furthermore, yoga positively influences oxidative stress by boosting antioxidant levels and regulating stress hormones, thereby improving overall immune defense and reducing disease susceptibility.

Yoga's therapeutic benefits extend to individuals with chronic illnesses such as cardiovascular disease, diabetes, arthritis, and cancer. Studies indicate that yoga interventions improve physical symptoms, psychological well-being, and quality of life in these populations. Mechanistically, yoga balances the autonomic nervous system, reduces inflammation, improves insulin sensitivity, and promotes emotional well-being. Despite promising outcomes, current research on yoga faces notable limitations. Many studies are constrained by small sample sizes, lack of control groups, short intervention periods, and limited randomized controlled trials. Additionally, the diversity of yoga styles and the use of subjective outcome measures limit the generalizability of findings across broader populations.

To support the scientific findings, classical yogic texts such as the *Patanjali Yoga Sutras*, *Hatha Yoga Pradipika*, and *Bhagavad Gita* are explored to offer philosophical and textual validation of yoga's benefits on mind-body health. These texts emphasize the regulation of mental fluctuations, control of breath (pranayama), and cultivation of ethical living and mindfulness, all of which contribute to psycho-physiological harmony. Ancient principles like "Yogaś citta-vṛtti-nirodhaḥ" (yoga is the cessation of mental fluctuations) and practices like pranayama and asana are aligned with modern concepts of mental health and immune regulation.

The literature strongly supports yoga as a multidimensional intervention with both psychological and immunological benefits. While further rigorous studies are needed to strengthen the evidence base, existing research and ancient texts collectively affirm the value of yoga in enhancing psychological well-being, boosting immune function, and managing chronic disease.

CHAPTER -IV
RESEARCH METHODOLOGY

Aims:

To evaluate the effects of different yoga practices on psychological well-being and immune system functioning in youths.

Objectives of the study:

- This study is to investigate the impact of yoga practices on psycho-immunological changes among youths.
- To evaluate the long-term yoga (kriya and asana) practice in fresh Post graduate yoga students.
- To suggest and recommend yogic practices for better psycho-immunological development.

Hypothesis:

Null Hypothesis (H0): There is no significant difference in psycho-immunological changes between youths who practice yoga.

Alternative Hypothesis (H1): There is a significant difference in psycho-immunological changes in pre and post intervention of yoga practices on psychoimmunology changes among healthy youths.

Participants:

The research participants were youths aged between 18 and 30 years, selected based on specific inclusion and exclusion criteria. The participants were recruited from three deferent yoga institution. Participants were required to have no prior significant experience with yoga and no serious medical conditions that could interfere with the study. Informed consent was obtained from all participants, ensuring their understanding of the study's objectives and procedures. Gender and age were considered in the selection process to ensure diversity within the sample. The participants in the experimental group were instructed to follow a 12-month yoga program. Demographic information, including age and gender, was collected to describe the sample and analyse potential influences on the outcomes. Participants' psychological and immunological measures were assessed before and after the intervention. All data were treated

confidentially, and participants had the right to withdraw at any time. The ethical guidelines of the Institutional Review Board (IRB) were followed throughout the study.

Inclusion criteria:

- M.Sc. I year students from the yoga department
- Age group 18 to 30 years young adult included for the study
- The participants must be healthy and willing to give informed consent.
- Participants with no previous experience of regular yoga practice (less than 1 months)

Exclusion criteria:

- M.Sc. II-year Yoga students and other department students excluded from the study.
- Individuals who have practiced yoga regularly for more than 1 months prior to the study.
- Subjects currently under medication, including those for chronic conditions, mental health disorders.
- Participants who are unwilling to follow the study protocol or drop out during the study period.

Study Design:

The present study employed a convenience sampling with a single arm design, the study has experimental group and base line itself considered as control data. The experimental group consists of three different yoga institutions, each with its own set of participants Mangalore University (n=32) subjects, Davangere University (n=23) subjects, and Central University of Kerala (n=12) subjects. The postgraduate students of a university who are enrolled in yoga M.sc programs. the study focused on fresh students who are new to yoga practices. Experimental group was introduced to a valid yoga protocol which was framed by expert committee. Yoga sessions were conducted for five days in a week for the duration of 2 hours morning and early evening.

Place of study:

The study was conducted at the following institutions:

- Department of Human Consciousness & Yogic Sciences, Mangalore University, Mangalagangotri - 574 199, Karnataka.
- Department of Yoga, Central University of Kerala,Tejaswini Hills,Periye (PO),Kasaragod (DT), Kerala-671320 INDIA.

- Department of Yogic Science, Davangere University,Shivagangotri, Davangere-577007, Karnataka.

Informed consent:

A written consent was obtained from all the subjects after explaining all details about the present study including purpose of the study, objective, methods, collection of data, procedure of yoga practices and duration. all participants were assured of the confidentiality of their data and given freedom to withdraw from the study at any point in time without any hesitation.

Case History Recordings:

Detailed case histories of all the subjects were taken systematically and maintained carefully. Many aspects like, history of present illness, history, family history, physical examinations like, sleep, appetite, micturition, bowel were noted. Blood pressure, weight and height were recorded. Blood pressure using sphygmomanometer and weight is determined using weighting machine.

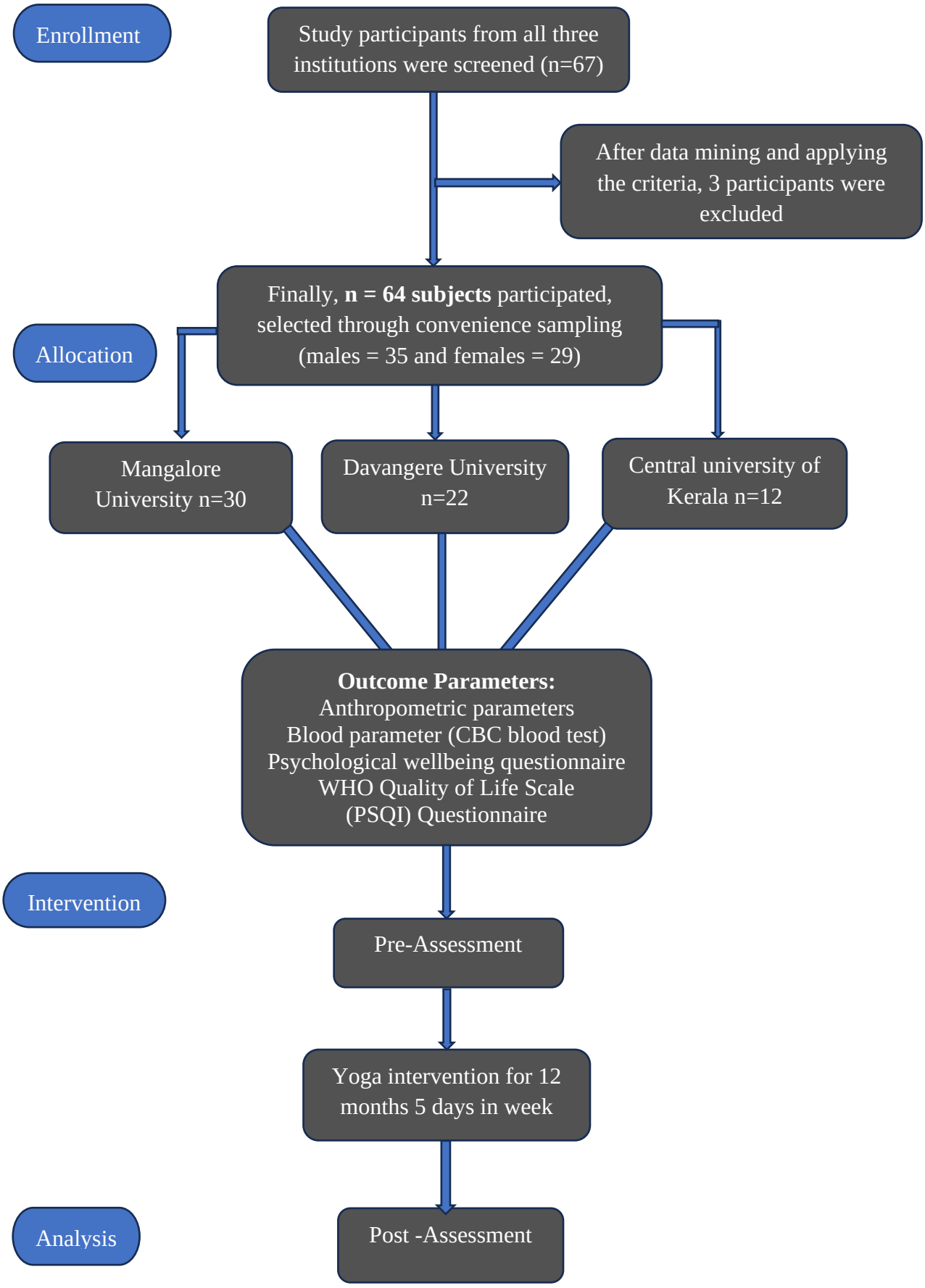
Medical Assessment:

The selection of the subjects and the assessment of the clinical condition were done under the guidance of medical field expert.

Subject Recruitment:

Participants are recruited through department referrals, visiting yoga institutions. Informed consent is obtained to ensure voluntary participation. They are selected based on specific criteria that align with the study's objectives. Specifically, M.Sc. first-year students were chosen from multiple centers across various universities. Participants were selected from the pool of students in the Yoga departments using this sampling approach. The convenience sampling method prioritized ease of access, selecting individuals who were readily available and willing to participate. By focusing on students from these departments, the recruitment process was streamlined, and the selection of participants was simplified, ensuring a feasible and accessible pool of participants for the study

Study flow diagram:


Enrollment
Study participants from all three institutions were screened (n=67)
After data mining and applying the criteria, 3 participants were excluded
Finally, n = 64 subjects participated, selected through convenience sampling (males = 35 and females = 29)
Allocation
Mangalore University n=30
Davangere University n=22
Central university of Kerala n=12
Outcome Parameters:
Anthropometric parameters
Blood parameter (CBC blood test)
Psychological wellbeing questionnaire
WHO Quality of Life Scale
(PSQI) Questionnaire
Intervention
Pre-Assessment
Yoga intervention for 12 months 5 days in week
Analysis
Post -Assessment

These participants were from three universities Mangalore University (30 participants), Davangere University (22 participants), and Central University of Kerala (12 participants). For the intervention phase, all 64 participants practiced yoga for one year, with a frequency of five days per week. After completing the one-year yoga intervention, participants were assessed again to measure post-intervention data and evaluate changes in their health.

Research Framework:

The research adopted a convenience sampling method with a one-group design. The study was conducted over two academic years, 2022-23 and 2023-24. The screening process occurred in the first week of each academic year, initially involving 67 participants. However, after data mining and applying the inclusion and exclusion criteria, 3 participants were excluded, leaving 64 eligible participants (males=35 and females=29) for the study.

Sample size:

The participant flow in this study involved a total of 67 participants initially, after the data mining 3 are exclude with 64 individuals assessed for eligibility based on the inclusion and exclusion criteria. These participants were from three universities Mangalore University (30 participants), Davangere University (22 participants), and Central University of Kerala (12 participants). This participant flow process, from initial assessment to final analysis, ensures clarity and transparency in participant management throughout the study.

Outcome measures:

1. Anthropometric parameters:

Anthropometric parameters play a crucial role in assessing the participants physical characteristics and a person's health and development status by measuring their body. This includes such as body weight, body height, body mass index (BMI) and waist circumference. The parameters can help identify potential disease risks in adults.

1. **Height:** Height is a basic measurement that reflects the overall growth and development of an individual. It is used to calculate other health parameters such as BMI and can also provide insight into genetic factors or certain medical conditions. For example, shorter stature might be linked with certain health risks, such as cardiovascular disease, while an individual's height can also be used to track their growth patterns over time in children and adolescents.

2. **Weight:** Weight is another fundamental metric used to evaluate an individual's health status. It is measured in kilograms or pounds and helps in understanding body composition, which can be an indicator of nutrition, fitness, or the presence of certain medical conditions. Weight is often compared against height to calculate BMI, which offers a more standardized measure of whether a person is underweight, healthy weight, overweight, or obese.
3. **Body Mass Index (BMI):** BMI helps identify whether a person is at risk for conditions related to underweight or obesity, such as malnutrition, heart disease, diabetes, and certain cancers. However, BMI does not differentiate between muscle mass and fat, so athletes or people with high muscle mass may have a higher BMI despite having low body fat. It is calculated using BMI=Weight (kg)Height (m)2.
4. **Blood Pressure (BP):** Blood pressure is the force of blood against the walls of the arteries as the heart pumps it around the body. It is measured in millimetres of mercury (mmHg) and recorded as two values. Systolic pressure (the upper number): Measures the pressure in your arteries when your heart beats. Diastolic pressure (the lower number): Measures the pressure in your arteries when your heart rests between beats. Normal blood pressure is generally considered to be around 120/80 mmHg.

2. Blood parameter (CBC blood test):

Blood parameters are measurable components of blood that provide vital information about a person's overall health and help diagnose, monitor, or manage medical conditions. A complete blood count (CBC) test helps assess the immune system by analyzing the number, size, and types of cells in the blood. It has measured several blood components, including red and white blood cells, platelets, hemoglobin, hematocrit, and mean corpuscular volume (MCV).

Table 1: Blood parameters

CBC Component	Immune Role
White Blood Cells (WBC)	Main defense cells; increased WBC indicate infection, inflammation, or immune response. Low WBC suggest immune suppression. There are five major types of white blood cells. A CBC test measures the total number of white cells in your blood. A different test called a CBC with differential measures the number of each type of these white blood cells.
Lymphocytes	Critical for adaptive immunity. Altered levels may reflect viral infections, autoimmune conditions, or immune deficiency.
Neutrophils	First responders to bacterial infection. High levels suggest acute bacterial infection; low levels can indicate vulnerability.
Monocytes	Involved in phagocytosis and antigen presentation. Elevated in chronic inflammation or infection. Help clean up pathogens and dead cells.
Eosinophils	Respond to allergens and parasitic infections. High eosinophil count indicates allergy or parasitic disease.
Platelets	Play a role in clotting and immune signaling. Altered counts can indicate inflammation or autoimmune disease.
Haemoglobin	Though not immune cells, they ensure oxygen delivery to immune tissues. Low levels (anemia) can weaken immune function.
Red Blood Cell (RBC)	low RBC or haemoglobin levels) can weaken the immune response by reducing oxygen delivery to immune cells.
Hematocrit, MCV, MCH	Reflects nutritional status and oxygen-carrying capacity of blood, it supporting immune efficiency.

3. Questionnaires:

1. WHO Quality of Life Scale (WHOQOL):

The WHO Quality of Life (WHOQOL) Scale is a comprehensive tool developed by the World Health Organization to assess an individual's overall quality of life across various domains. It evaluates physical health, psychological well-being, social relationships, and the environment, offering a holistic view of a person's life satisfaction. The scale includes different versions, such as the WHOQOL-BREF (with 26 questions), which is more commonly used due to its brevity and ease of administration. The WHOQOL scale is valuable in both clinical and research settings, helping to assess the impact of health conditions or treatments on a person's quality of life and exploring the connections between health and overall well-being. It is widely used across cultures, ensuring its applicability in diverse populations and settings.

1. Psychological wellbeing questionnaire

The Scales of Psychological Well-being is a theoretically grounded, multidimensional model of well-being that was designed to include six distinct components of positive psychological functioning including positive self-regard (self-acceptance), mastery of the surrounding environment, quality relations. The 18-item version of Ryff's Psychological Wellbeing Scale (Ryff and Keyes, 1995) is a self-report instrument that comprises 18 items measuring six dimensions of psychological wellbeing: autonomy, environmental mastery, self-acceptance, personal growth, positive relations with others, and purpose in life.

2. Pittsburgh Sleep Quality Index (PSQI):

The Pittsburgh Sleep Quality Index (PSQI) is a widely used tool designed to assess an individual's sleep quality and disturbances over a one-month period. The PSQI consists of 19 self-report questions organized into seven components subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored from 0 to 3, with higher scores indicating worse sleep quality. The total score ranges from 0 to 21, with a score of 5 or more suggesting poor sleep quality. The PSQI is valuable in both clinical and research settings for identifying sleep-related issues such as insomnia or sleep apnea, evaluating treatment efficacy, and tracking changes in sleep patterns over time. Its simplicity and comprehensive nature make it an essential tool for understanding and addressing sleep disturbances.

Yoga Protocol and Intervention Details:

Validating a yoga practice with an expert committee typically involves an evaluation process to ensure the practice aligns with established guidelines, principles, and standards in yoga research. These assessments played a pivotal role in refining and validating the yoga module, ensuring its relevance and effectiveness in clinical practice. Accompanying documents outlining the aim and objectives of the study, as well as classical references informing the module's development, were provided for the experts' reference.

This validation process involved the experts reviewing accompanying documentation, which included the aim and objectives of the study, as well as classical references and theoretical underpinnings that informed the design of the yoga module. These references served to establish the authenticity and credibility of the practices being incorporated into the intervention. They ensured that the yoga practices used, such as Kriya, Asanas, Pranayama, and relaxation techniques, were in line with well-known yoga traditions and research-based standards.

The validated yoga protocol was taught to the experimental group over a period of 12 months. The participants practiced yoga through two sessions each day, one hour in the morning and one hour in the evening, five days a week. Both the morning and evening sessions of the yoga protocol were expertly taught by experienced faculty members, who ensured that each practice was delivered with precision and attentiveness. These instructors played a crucial role in guiding participants through the practices, offering modifications when necessary, and ensuring that each posture was performed correctly and safely. New asanas were introduced weekly, allowing participants to gradually build strength, flexibility, and stamina. The approach began with foundational poses and progressed to more advanced ones, ensuring continuous improvement throughout the program.

A key feature of this intervention is the consideration of individual needs, particularly for female participants during menstruation. Since certain asanas, especially those involving intense physical strain or inversion, may not be suitable during this time, the protocol recommends that women refrain from practicing asanas for five days of their menstrual cycle. Instead, they are encouraged to focus on pranayama and relaxation techniques, ensuring their comfort and safety while still engaging with the intervention.

The implementation of yoga practices in this study was carried out through a meticulously planned and systematically executed protocol. Every stage of the intervention was governed by clearly defined procedures to ensure consistency, replicability, and scientific rigor. The program emphasized adherence to standardized yoga routines, incorporating specific kriyas, asanas, pranayama, and meditation techniques, which were selected based on their documented psycho-immunological benefits. The structure of the intervention was designed to maintain uniformity across sessions, with clearly outlined durations, frequencies, and repetitions for each practice. Detailed information regarding the types of yoga practices, their sequence, duration, number of rounds, and timing is comprehensively documented in **Tables 2 to 3**.

Table 2: Specific Yoga module (kriya and asana - *Morning* ***1 hour).***

SN	**Name of the Practice**	**No of rounds/breathing**	**SN**	**Name of the Practice**	**No of rounds/ breathing**
1	Jalaneti	Once in morning up to 2 months	34	Marichasana 3 & 4	5 breathings
2	Kapalabhathi	5 rounds	35	Jatharaparivartha	5 breathings
3	Agnisara	2 times	36	Upavishtakonasana	5 breathings
4	Trataka	5 munities	37	Baddhakonasana	5 breathings
5	Sutraneti	Once in both the nostrils	38	Suptapadangusthasana	5 breathings
6	Gajakarani	1 time	39	Suptaparshvasahita	5 breathings
7	Vastradhauti	Morning time first 1 month	40	Ubhayapadangushtasana	5 breathings
8	Shankhaprakshalana	Once in a study	41	Urdhwamukha Paschimottanasana	5 breathings
9	Nauli	2 times	42	Bharadwajasana	5 breathings
10	Kapalabhati - variations	3 rounds	43	Ardhamatsyendrasana	5 breathings
11	Svastikasana	5 breathings	44	Simhasana	5 breathings
12	Tadasana 1	5 times	45	Akarna dhanurasana	5 breathings
13	Tadasana 2	5 times	46	Paryankasana	5 breathings

14	Vaidikasuryanamaskara – 9 vinyasa	3 times	47	Shirshasana	5 breathings
15	Siddhasana	5 breathings	48	Shavasana I	5 minutes
16	Padmasana	5 breathings			
17	Baddha padmasana	5 breathings			
18	Pashasana	5 breathings			
19	Shalabhasana	5 breathings			
20	Bhekasana	5 breathings			
21	Dhanurasana	5 breathings			
22	Parshvasahitadhanurasana	5 breathings			
23	Ustrasana	5 breathings			
24	Vajrasana	5 breathings			
25	Suptavajrasana	5 breathings			
26	Pavanamuktasana	5 breathings			
27	Bhujangasana	5 breathings			
28	Urdhwa padmasana	5 breathings			
29	Pindasana	5 breathings			
30	Matsyasana	5 breathings			
31	Uttanapadasana	5 breathings			
32	Garbhapindasana	5 breathings			
33	Kukkutasana,	5 breathings			

Table 3: Specific Yoga module (Asanas & Pranayama – *Evening* ***1 hour).***

SN	Name of the Practice	No of rounds/breathing	SN	Name of the Practice	No of rounds/ breathing
1	YaugikaSuryanamaskara – 17 Vinyasa	3 times	34	Kraunchasana	5 breathings
2	Padangusthasana	5 breathings	35	Mayurasana	5 breathings
3	Padahastasana	5 breathings	36	Laghuvajrasana	5 breathings
4	UtthitaTrikonasana	5 breathings	37	Kapotasana	5 breathings
5	ParivrttaTrikonasana	5 breathings	38	Paschimottanasana – III	5 breathings
6	UtthitParshvakonasana	5 breathings	39	Nakrasana	Front 5 times and back 5 times moving
7	Prasarithapadottanasana	5 breathings	40	Matsyendrasana	5 breathings
8	Parshvottanasana	5 breathings	41	Vishwamitrasana	5 breathings
9	UtthitaPadangusthasana	5 breathings	42	Gomukhasana	5 breathings
10	Ardhabaddhapadmottanasana	5 breathings	43	Parvatasana	5 breathings
11	Veerabhadrasana	5 breathings	44	Chakrasana	5 breathings
12	Paschimottanasana	5 breathings	45	Garudasana	5 breathings
13	Purvottanasana	5 breathings	46	Ekapadashirshasana	5 breathings
15	Janushirshasana	5 breathings	47	Dwipadashirshasana	5 breathings
16	Tiryanmukhaikapadapaschimottanasana	5 breathings	48	Yoganidrasana	5 breathings
17	Marichasana 1	5 breathings	49	Suptakonasana	5 breathings
18	Marichasana 2	5 breathings	50	Shavasana II	5 minutes
19	Navasana	5 breathings			
20	Bhujapeedasana	5 breathings			
21	Setubandhasana	5 breathings			

22	Viparitakarani,	5 breathings			
23	SalambaSarvangasana	5 breathings			
24	Halasana	5 breathings			
25	Ujjayi	21 times			
26	Anuloma-viloma	21 times			
27	Pranava	12 times			
28	Yaugika Suryanamaskara – 12 Vinyasa	3 rounds			
29	Utkatasana	5 breathings			
30	Natarajasana	5 breathings			
31	Vatayanasana	5 breathings			
32	Parighasana	5 breathings			
33	Yogamudra	5 breathings			

Data Collection:

To conduct the study all three institutional approval was obtained from the relevant yoga departments. The data collection process began with the recruitment of participants. At the beginning of the intervention, participants were personally contacted, and provided with detailed information about the research objectives, procedures, and methodology. Once they fully understood the study's aims and methodology, participants voluntarily agreed to participate. The data collection process began with the recruitment of participants. At the beginning of the intervention, participants were personally contacted, and provided with detailed information about the research objectives, procedures, and methodology. Once they fully understood the study's aims and methodology, participants voluntarily agreed to participate. After thoroughly understanding the aims and methods of the study, participants voluntarily consented to participate. The data collection phase involved administering various standardized assessments to evaluate psycho-immunological factors such as stress levels, immune system markers, mental well-being, and emotional resilience, alongside gathering

comprehensive case histories that included socio-demographic data, lifestyle factors, and relevant health concerns.

Following data collection, responses were obtained from all participants with informed consent, and the data underwent rigorous processing, including coding, scoring, and conversion of raw scores into standardized values. Thorough checks were conducted to identify inconsistencies, missing data, or errors, and only complete, error-free responses were retained for further analysis, while incomplete or inconsistent data were excluded. Throughout the study, measures were implemented to ensure participant confidentiality, safety, and a clear understanding of the research procedures, with efforts to uphold ethical standards and protect participant rights.

Statistical Analysis:

The goal of the statistical analysis was to determine whether there was a statistically significant difference between pre- and post-intervention measurements for participants in the experimental group who practiced yoga. The analysis further explored whether changes in psychological and immunological parameters were associated with the intervention and whether these associations remained robust after controlling for confounding variables, such as age and initial health conditions. SPSS software was chosen for its robust statistical capabilities, user-friendly interface, and ability to handle large datasets effectively. Given its widespread use in psychological and medical research, SPSS provided a reliable tool for conducting this study.

Several key statistical techniques were employed to draw meaningful conclusions from the data. Descriptive statistics were first used to summarize and describe the primary characteristics of the study population and the measured parameters. These statistics provided an overview of the data's central tendencies, distributions, and variability, offering a clear snapshot of the study sample. Paired t-tests were then used to assess the impact of the intervention within the experimental group by comparing pre- and post-intervention data. This method allowed for the identification of statistically significant changes in key parameters, helping to determine whether the yoga intervention had a measurable effect. Analysis of Covariance (ANCOVA) was applied to compare the adjusted means between pre- and post-measurements within the experimental group, while controlling for potential confounding variables, such as age and initial health conditions.

Finally, correlation analysis was performed to explore the relationship between psychological well-being and immunological parameters. This analysis provided valuable insights into how these variables may be interconnected, further enhancing the understanding of the effects of the intervention. Together, these statistical techniques ensured the rigor and validity of the study's findings, offering a comprehensive understanding of the effects of yoga on psychological and immunological health.

CHAPTER -V

RESULT AND STATISTICAL ANALYSIS

Introduction

The findings of the study, which was conducted over a 12-month period involving first-year M.Sc. Yoga students from three universities Mangalore University, Davangere University, and the Central University of Kerala. The statistical analysis is central to validating the research hypothesis regarding the impact of yoga practices on psycho-immunological markers among youth. This chapter outlines the methodology employed for data collection and details the statistical techniques used for data analysis, including descriptive statistics, paired t-tests, and correlation analysis, to highlight significant trends and outcomes. Graphs and tables are provided to facilitate a clearer understanding of the observed changes. The data analysis was performed using SPSS software, renowned for its robust statistical capabilities.

Participant Baseline Characteristics

Establishing a clear baseline is essential for accurately assessing the effects of any intervention. This section outlines the initial characteristics of the study participants, providing a comprehensive overview of their demographic, physiological, and health-related status prior to the yoga intervention. These baseline profiles act as a foundational reference, allowing for meaningful interpretation of changes observed after the intervention. A thorough understanding of these initial conditions is critical for evaluating the influence of yoga on various aspects of immune function and psychological well-being.

A total of 64 participants were enrolled in the study, including 35 males and 29 females, drawn from three academic institutions the Central University of Karnataka (CUK), Davangere University (DVG), and Mangalore University (MU). The age of participants ranged from 20 to 50 years, with a mean age of 24.4 ± 5.3 years, representing a predominantly young adult population. The average height was 163.2 ± 8.4 cm, while the mean pre-intervention weight was 58.3 ± 8.7 kg. The Body Mass Index (BMI) ranged from 16.0 to 28.5 kg/m², with a mean value of 21.3 ± 2.6 kg/m², indicating a distribution from underweight to overweight categories. Baseline systolic blood pressure averaged 118.6 ± 6.8 mmHg, and diastolic blood pressure averaged 75.5 ± 5.4 mmHg, both within clinically normal limits.

Paired t-Test Analysis Statistical results on changes in anthropometric, psychological measures and immunological parameters.

Paired t-tests were performed to compare the means of the pre- and post-intervention measurements within the experimental group. This statistical approach is appropriate for evaluating repeated measures on the same subjects, allowing for the assessment of within-group changes over time. By analyzing paired data, this test helps determine whether any observed differences in anthropometric (weight, BMI, BP), psychological (psychological health, quality of life, sleep), and immunological (white blood cell counts, cytokine levels, RBC, haemoglobin, platelets) parameters are statistically significant and not due to random variation. The paired t-test enhances the sensitivity of the analysis by accounting for individual variability, making it a robust method for detecting the effects of the intervention.

Anthropometric Parameters

In this study, important factors such as age, weight, Body Mass Index (BMI), blood pressure, were carefully measured. These values establish a baseline that is vital for assessing how yoga influences body composition and health.

Table 4: comparison of pre-post scores of Anthropometric Measurements in Experimental (yoga) group.

Paired t- test yoga group pre -post	**Mean**	**SD**	**SEM**	**95 percent confidence interval**		**t-value**	**Df**	**P- value**
				Lower	**Upper**			
Weight	-2.154	2.563	0.3179	2.789	1.519	6.775	63	<0.0001
BMI	-0.7954	0.9416	0.1168	1.029	0.5621	6.810	63	<0.0001
BP Systolic	-0.7954	0.9416	0.1168	1.029	0.5621	6.810	63	<0.0001
BP Diastolic	-3.000	4.316	0.5353	4.069	1.931	5.604	63	<0.0001

Weight:

A paired sample *t*-test was conducted to evaluate the effect of the yoga intervention on participants' body weight. The analysis shows a statistically significant reduction in weight

post-intervention, with a mean change of –2.154 kg (SD = 2.563 kg). The negative mean difference indicates an average weight loss among the participants following the intervention. The standard error of the mean (SEM) was 0.3179, suggesting a high precision in the estimate of the population mean. The computed *t*-value was 6.775, which is substantially higher than the critical value for statistical significance at the 0.05 level. This result shows that the intervention caused a significant reduction in body weight, these findings suggest that the yoga program had a significant and consistent effect in reducing body weight among participants.

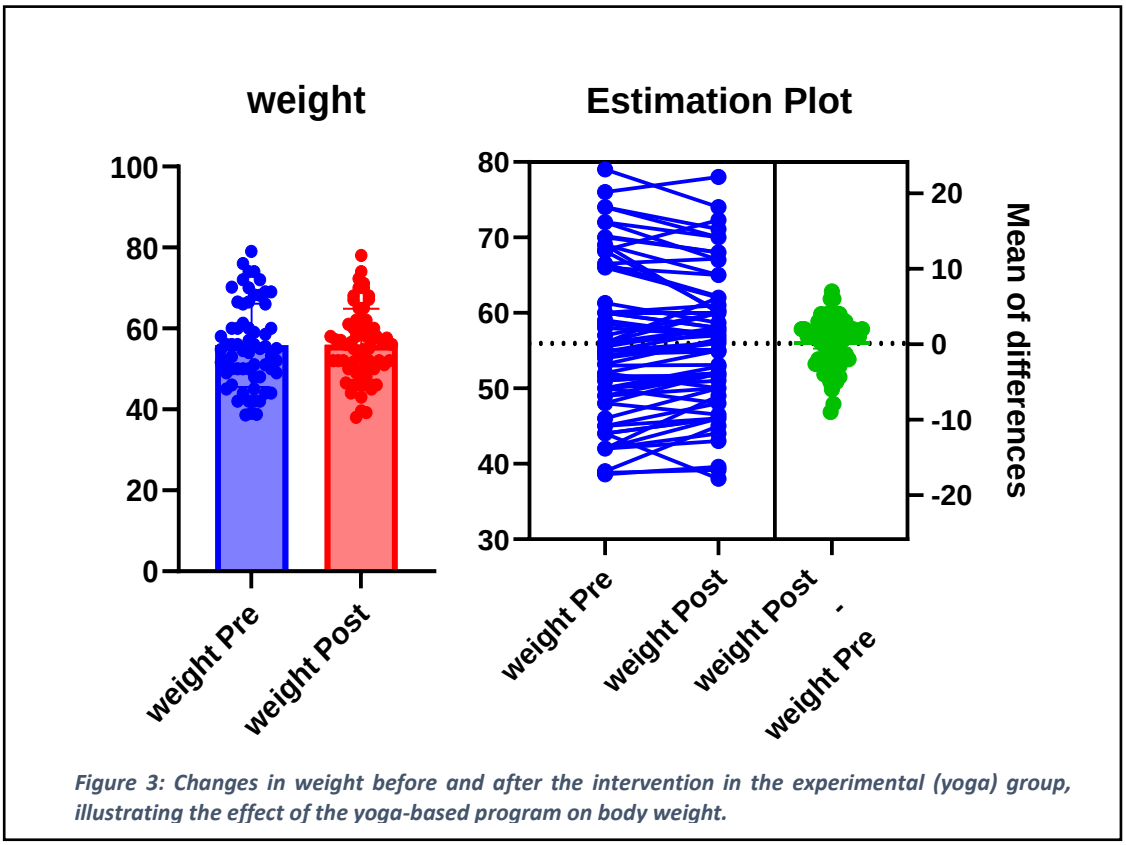


Figure 3: Changes in weight before and after the intervention in the experimental (yoga) group, illustrating the effect of the yoga-based program on body weight.

Body Mass Index (BMI)

The analysis showed a statistically significant reduction in BMI, with a mean change of –0.7954 units (SD = 0.9416). The SEM was 0.1168, and the t-value of 6.810 provides strong evidence to reject the null hypothesis. This reduction in BMI, consistent with decreased body weight, supports the effectiveness of the yoga intervention in improving body composition. The observed decrease in BMI aligns with the concurrent reduction in body weight and reinforces the efficacy of the yoga intervention in improving body composition.

Given BMI's link to metabolic and cardiovascular health, even a modest but significant decrease highlights yoga's potential as a valuable health management tool.

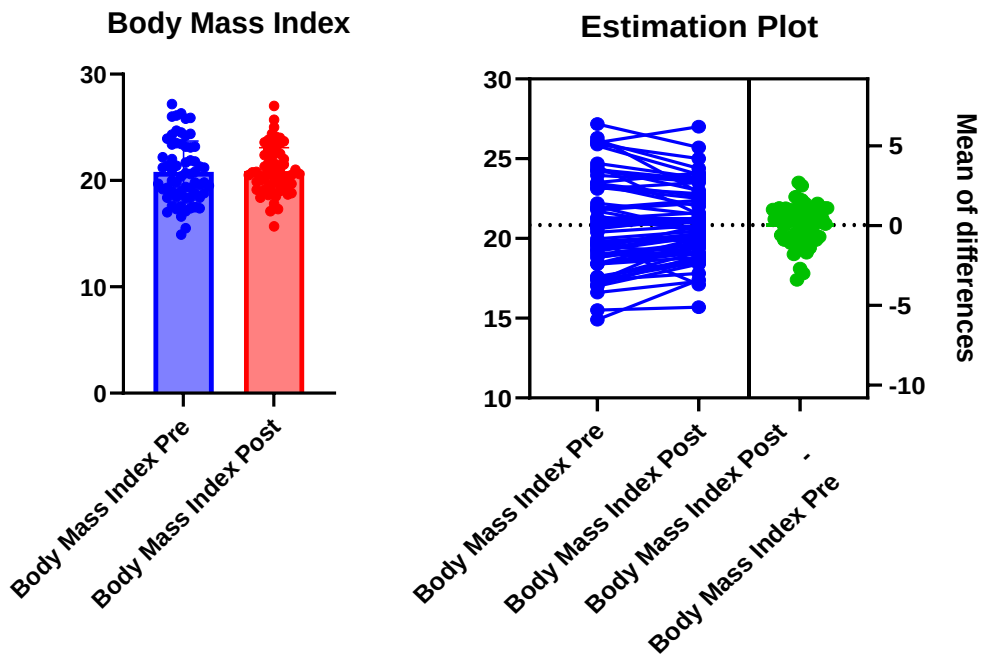


Figure 4: Effect of the yoga intervention on Body Mass Index (BMI) before and after the program.

Blood Pressure — Systolic and Diastolic:

Systolic Blood Pressure (BP)

Systolic blood pressure (SBP), which represents the arterial pressure during cardiac contraction, showed a statistically significant reduction following the yoga intervention. The mean change was –0.7954 mmHg (SD = 0.9416; SEM = 0.1168). the paired *t*-test yielded a *t*-value of 6.810 with a *p*-value < 0.0001, indicating that the change was highly statistically significant.

The low SEM suggests a precise estimate of the population mean, and the high *t*-value reflects consistency in the observed effect across participants. While a reduction of less than 1 mmHg may have limited immediate clinical relevance, it may signal early improvements in cardiovascular regulation attributable to regular yoga practice.

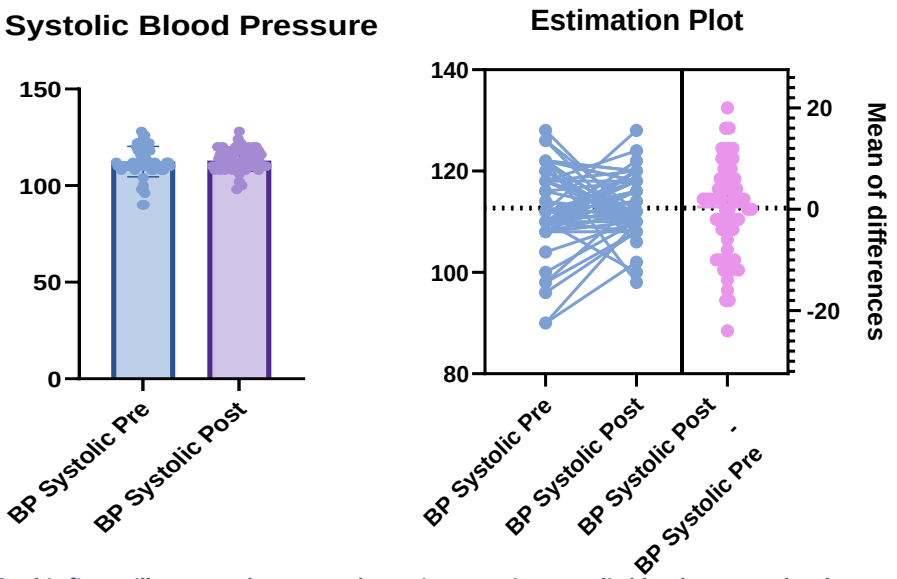


Figure 5: This figure illustrates the pre- and post-intervention systolic blood pressure levels among participants in the yoga group.

Diastolic Blood Pressure

The paired t-test analysis shows a significant reduction in diastolic blood pressure following the yoga intervention. The mean difference of -3.000 mmHg indicates that participants experienced decrease in DBP after the intervention. The standard deviation (SD) of 4.316 and standard error of the mean (SEM) of 0.5353 suggest moderate variability in the response and good precision of the estimate. The 95% confidence interval (CI) ranges from -4.069 to -1.931, reinforcing the reliability of the observed decrease. Since the entire CI lies below zero, it confirms a true reduction in DBP. With a t-value of 5.604, degrees of freedom = 63, and a p-value < 0.0001, the result is highly statistically significant.

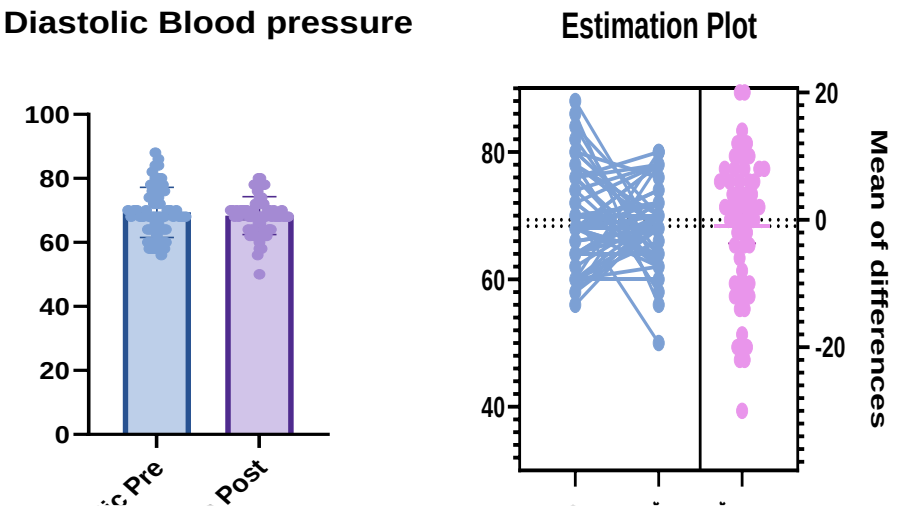


Figure 6: This figure illustrates the changes in diastolic blood pressure before and after the yoga intervention among participants.

Psychological Health Assessment Tools

In this study, psychological health was comprehensively assessed using three validated tools the WHOQOL-BREF, the Pittsburgh Sleep Quality Index (PSQI), and the Psychological Well-Being Questionnaire. Together, these instruments provide a multidimensional view of participants' mental and emotional health.

Table 5: Comparison of Pre- and Post-Intervention Scores of Psychological Questionnaires in the Yoga Group (Paired t-test Analysis).

Paired t- test yoga group pre -post	**Mean**	**SD**	**SEM**	**95 percent confidence interval**		**t-value**	**Df**	**P-value**
				Lower	**Upper**			
Psychological Well-Being	7.813	2.782	0.3478	7.117	8.508	22.46	63	<0.0001
WHO Quality of Life Scale	2.477	2.191	0.2739	1.930	3.025	9.046	63	<0.0001
Pittsburgh Sleep Quality Index (PSQI) Questionnaire	-1.891	1.071	0.1338	-2.158	1.623	14..13	63	<0.0001

<u>Psychological Wellbeing Questionnaire</u>

A paired samples t-test was conducted to assess the effect of yoga on psychological well-being. The results showed a statistically significant increase in scores from pre- to post-intervention, with a mean improvement of 7.813 points (SD = 2.782, SEM = 0.3478). The 95% confidence interval for the mean difference ranged from 7.117 to 8.508, and the t-test revealed a highly significant result, $t(63) = 22.46$, $p < 0.0001$. This substantial increase suggests that the yoga intervention had a strong and effective impact on various facets of psychological well-being, such as self-acceptance, personal growth, and emotional resilience. These findings suggest that the yoga practice had a highly significant impact on participants.

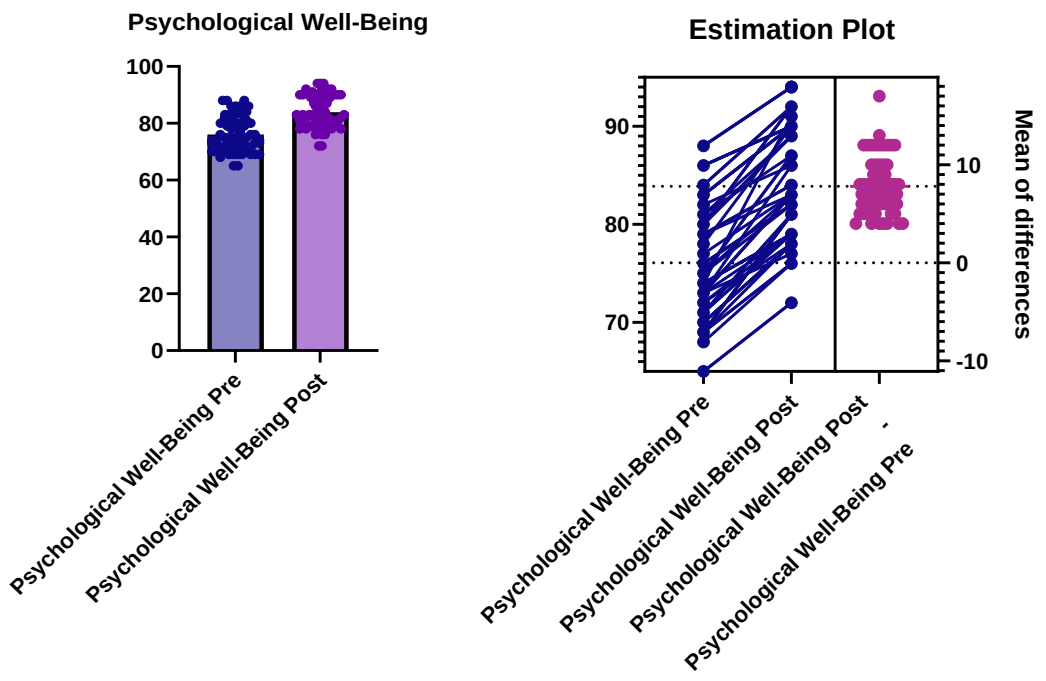


Figure 7: This figure presents the comparison of pre- and post-intervention scores on the Psychological Wellbeing Questionnaire. The upward shift in mean scores illustrates a statistically significant improvement in participants' psychological wellbeing following the yoga- intervention.

WHO Quality of Life Scale

To evaluate changes in psychological quality of life, a paired t-test was applied to WHOQOL-BREF psychological domain scores. Results indicated a significant enhancement in psychological quality of life following the yoga intervention, with a mean difference of 2.477 (SD = 2.191, SEM = 0.2739). The 95% confidence interval ranged from 1.930 to 3.025, with a t-value of $t(63) = 9.046$ and a p-value < 0.0001, The statistically significant improvements across all four WHOQOL-BREF domains highlight the holistic benefits of the yoga intervention. These findings support the efficacy of yoga in enhancing not only physical and psychological well-being but also social functioning and environmental satisfaction. providing strong statistical evidence against the null hypothesis. This confirms that the observed improvement is unlikely to be due to chance, and the intervention had a effective impact on participants' quality of life.

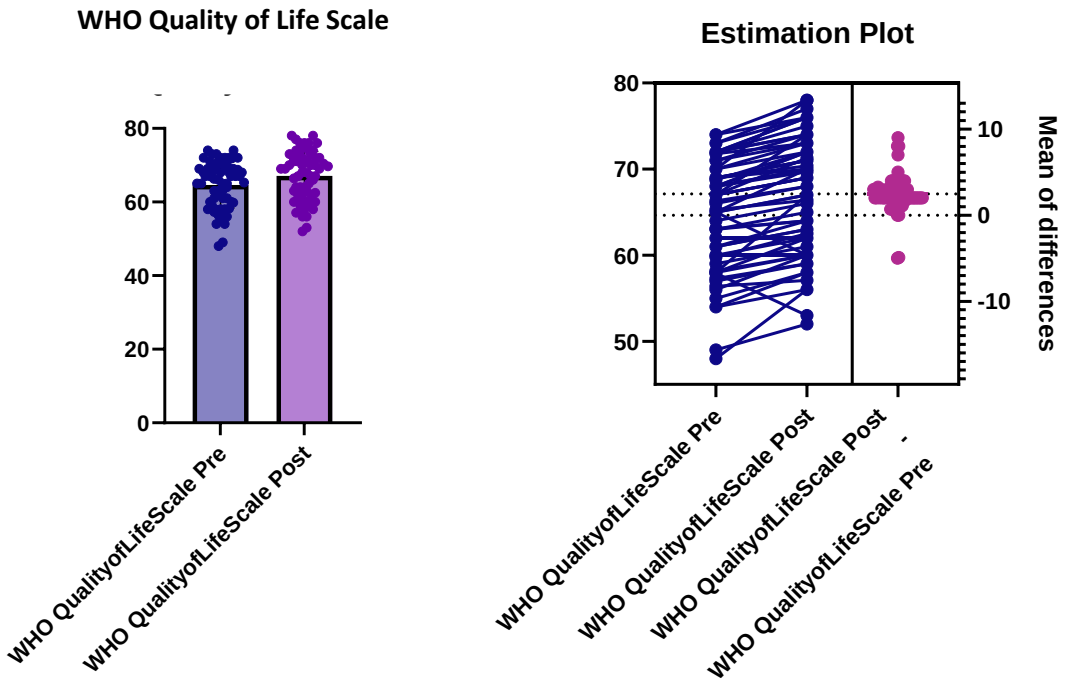


Figure 8: The figure presents a comparative analysis of WHOQOL scores before and after the yoga intervention. The observed upward shift in mean scores indicates a statistically significant improvement in participants' perceived quality of life across multiple domains.

Pittsburgh Sleep Quality Index (PSQI)

A significant improvement in sleep quality following the yoga intervention. The mean difference of -1.891 indicates that, on average, participants reported lower PSQI scores post-intervention. Since lower PSQI scores correspond to better sleep quality, this negative mean difference reflects a meaningful enhancement in sleep patterns. The standard deviation (SD) of 1.071 suggests relatively low variability in participants' responses, indicating that the observed improvements were consistent across the sample. The standard error of the mean (SEM) is 0.1338, demonstrating a high level of precision in estimating the mean difference and further supporting the reliability of the results. The 95% confidence interval ranged from -2.158 to -1.623, providing strong evidence that the true population mean lies within this interval. A t-value of 14.13 with 63 degrees of freedom and a p-value < 0.0001 confirms that the improvement in sleep quality is statistically significant and unlikely to have occurred by chance. These results highlight the effectiveness of the yoga intervention in promoting better sleep quality among participants.

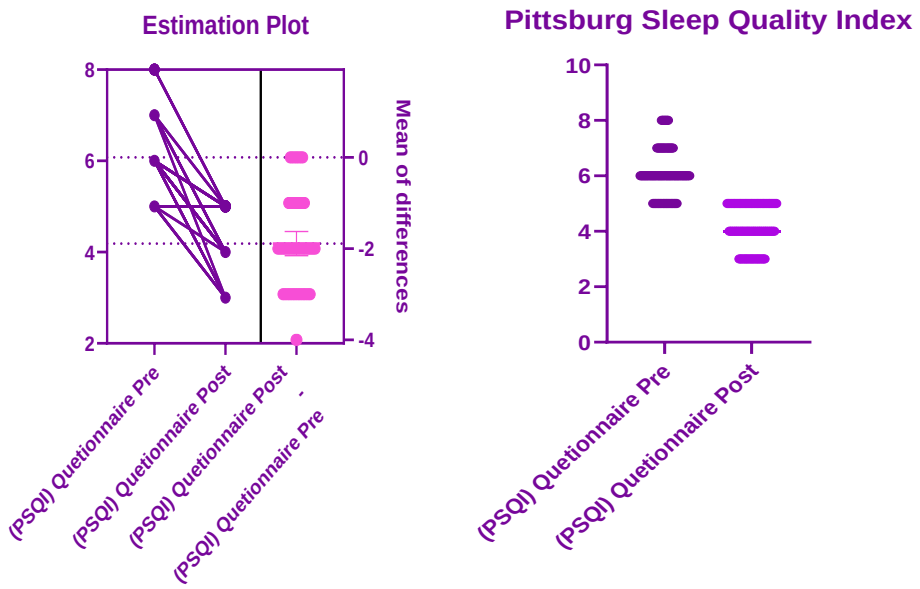


Figure 9: The figure displays a comparative analysis of Pittsburgh Sleep Quality Index (PSQI) scores before and after the yoga intervention. The downward shift in mean scores reflects a statistically significant improvement in sleep quality among participants.

Blood Parameters

The current analysis investigates the physiological effects of a yoga intervention on haematological parameters in a sample of 64 participants. The paired t-test was employed to compare pre- and post-intervention values for haemoglobin levels, white blood cell (WBC) count, Lymphocytes, Neutrophils, Monocytes, Eosinophils, Platelet Count, Haemoglobin, Red Blood Cells (RBCs), Hematocrit, Mean Corpuscular Volume (MCV), and Mean Corpuscular Haemoglobin (MCH), platelet count, and red blood cell (RBC) count. A paired t-test is an appropriate statistical method in this case because it compares means from the same group at two different times (before and after the intervention), thereby controlling for inter-individual variability. Each of these markers plays a crucial role in assessing immune function and physiological health.

Table 6: Comparison of Pre- and Post-Intervention Scores of Blood Parameters in the Yoga Group (Paired t-test Analysis).

Paired t- test yoga group pre -post	Mean	SD	SEM	95 percent confidence interval		t-value	Df	P-value
				Lower	Upper			
White Blood Cells	1270	1543	192.9	884.9	1656	6.586	63	<0.0001
Lymphocytes	9.672	13.43	1.679	6.317	13.03	5.762	63	<0.0001
Neutrophils	13.16	10.38	1.297	10.56	15.75	10.14	63	<0.0001
Monocytes	1.609	2.492	0.3115	0.9869	2.232	5.167	63	<0.0001
Eosinophils	1.055	0.6674	0.0834	0.8880	1.221	12.64	63	<0.0001
Platelet Count	0.2997	0.3872	0.0484	0.2030	0.3964	6.192	63	<0.0001
Haemoglobin	1.048	0.8427	0.1053	0.8379	01.259	9.953	63	<0.0001
Red Blood Cells	0.3672	0.6765	0.0845	0.1982	0.5362	4.342	63	<0.0001
Hematocrit	1.238	3.111	0.3889	0.4603	2.015	3.182	63	<0.0023
Mean Corpuscular volume	0.8344	1.565	0.1956	04435	1.225	4.266	63	<0.0001
Mean Corpuscular Haemoglobin	0.1619	1.296	0.1619	0.5342	1.181	5.297	63	<0.0001

White Blood Cell (WBC) Count

The paired t-test showed a mean increase of 1270 cells/μL (SD = 1543, SEM = 192.9), with the 95% confidence interval ranging from 884.9 to 1656. The result was highly significant, $t = 6.586$, $p < 0.0001$, significant enhancement in WBC counts post-yoga practice, indicating strong evidence to reject the null hypothesis of no change. The observed effect of physiological response, potentially attributable to the intervention. Given the established role of WBCs in immune surveillance and inflammatory regulation, the increase reflects an enhancement in immune function a normalization of immune parameters. The clinical interpretation, these

results should be evaluated in the context of baseline levels, reference ranges, and individual variability to assess whether the observed change falls within a therapeutically beneficial range.

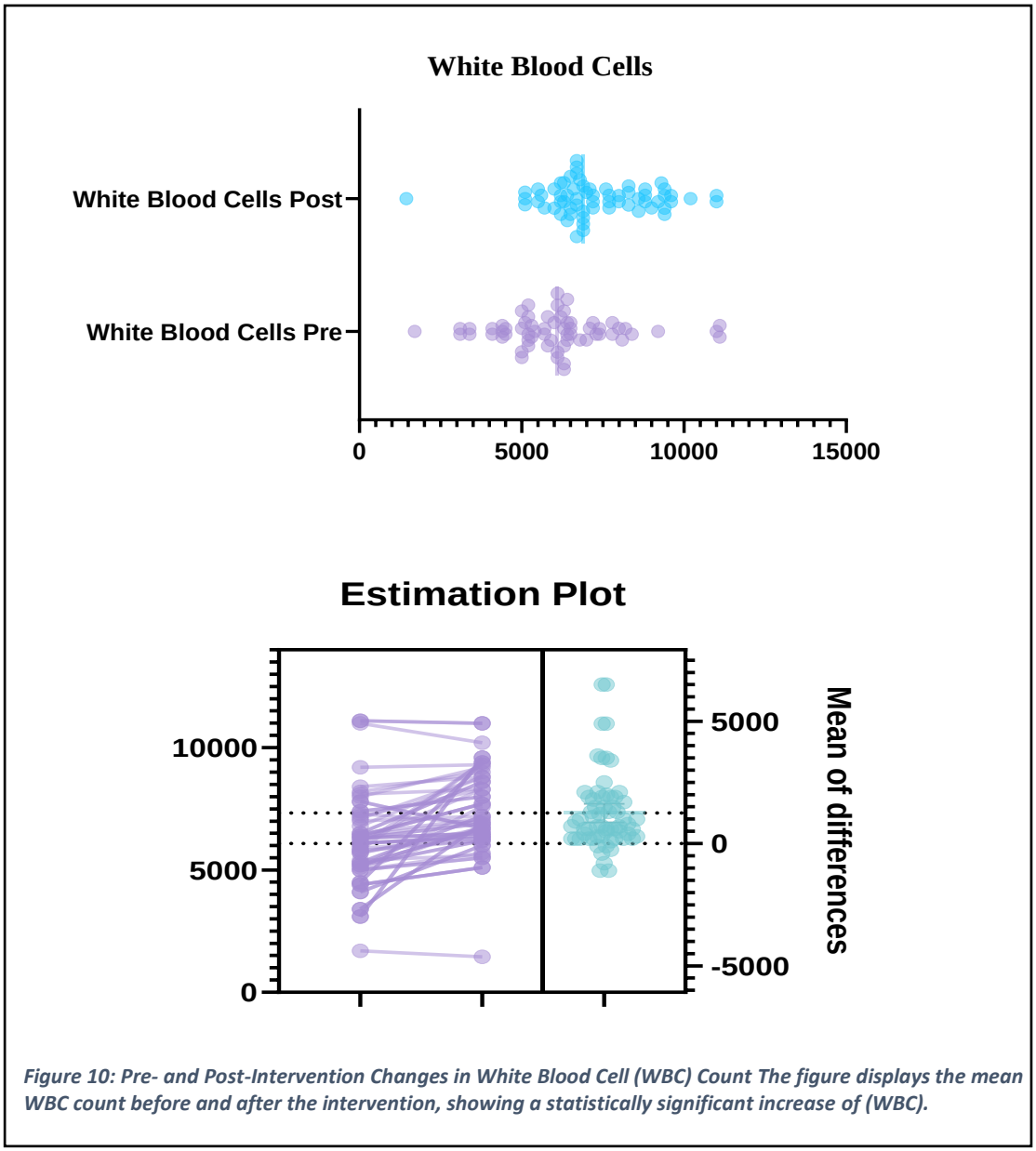


Figure 10: Pre- and Post-Intervention Changes in White Blood Cell (WBC) Count The figure displays the mean WBC count before and after the intervention, showing a statistically significant increase of (WBC).

Lymphocytes

A significant increase following the yoga intervention. The mean difference between pre- and post-intervention lymphocyte counts was 9.672, with a standard deviation of 13.43 and a standard error of the mean (SEM) of 1.679. The 95% confidence interval for the mean difference ranged from 6.317 to 13.03, indicating a high degree of precision in the estimate and suggesting that the true population mean difference lies within this interval. The t-value obtained was 5.762, with 63 degrees of freedom, and the corresponding p-value was less than 0.0001, indicating that the observed difference is statistically

highly significant. This result strongly supports the hypothesis that yoga has a positive effect on lymphocyte levels. From a physiological perspective, the increase in lymphocyte count suggests enhanced adaptive immune function, likely resulting from reduced stress and improved autonomic regulation associated with regular yoga practice.

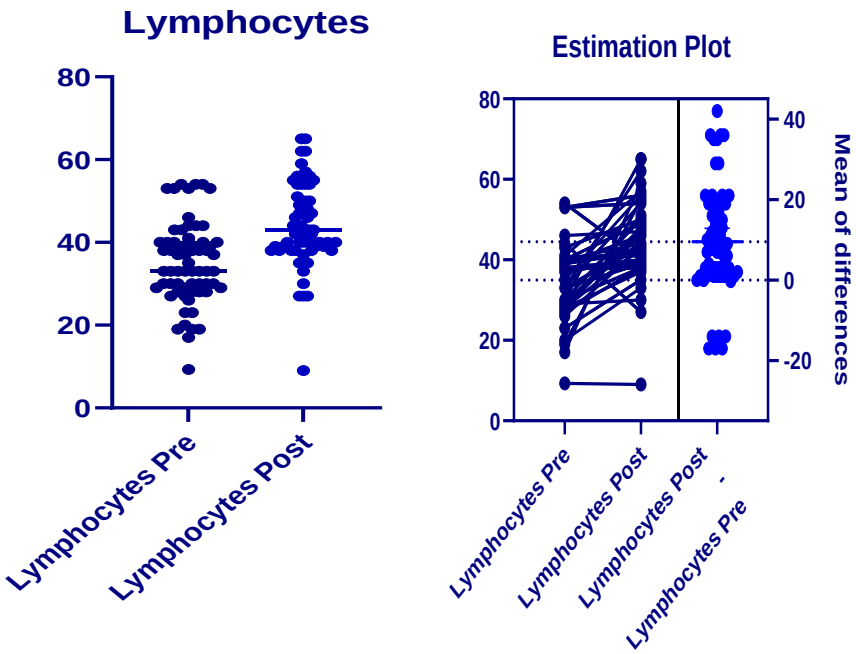


Figure 11: The figure illustrates the mean lymphocyte count before and after the intervention, demonstrating a statistically significant increase.

Neutrophils

The analysis of neutrophil levels before and after the yoga intervention demonstrated a statistically significant increase. The mean difference was 13.16, with a standard deviation of 10.38 and a standard error of the mean (SEM) of 1.297. The 95% confidence interval ranged from 10.56 to 15.75, indicating that the increase in neutrophil count is not only statistically significant but also clinically effectful.

The t-value was calculated as 10.14, with 63 degrees of freedom, and the corresponding p-value was less than 0.0001, confirming a highly significant difference between pre- and post-intervention values. This substantial rise in neutrophil count suggests a possible enhancement in innate immune readiness, as neutrophils serve as the body's first line of defense against

infections. These findings underscore the potential of yoga as a complementary practice for strengthening immune function

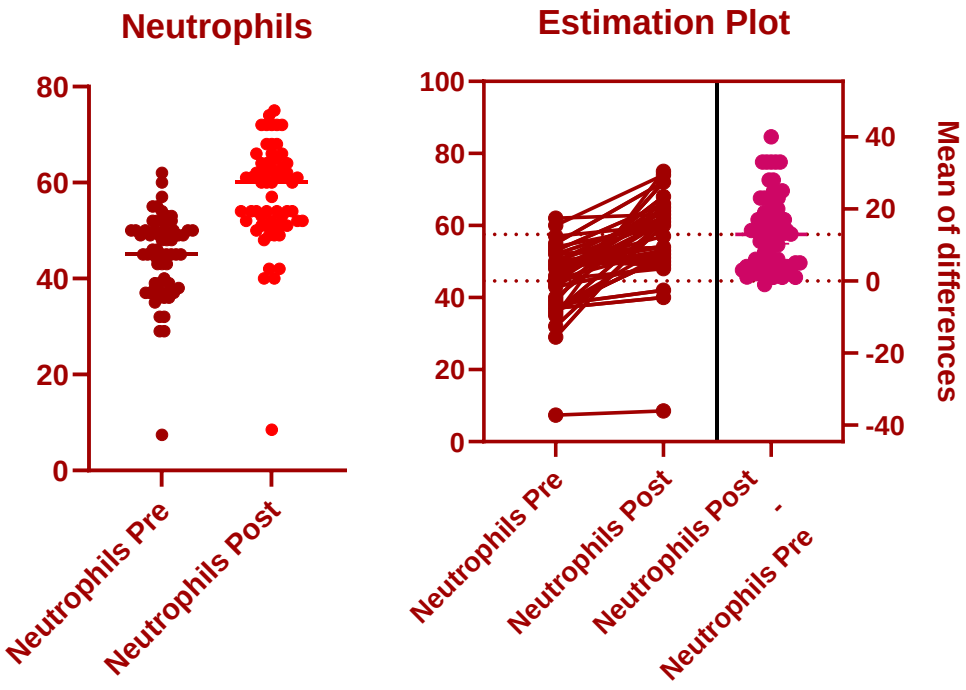


Figure 11: The figure illustrates the mean neutrophil count before and after the intervention, demonstrating a statistically significant increase.

Monocytes

The paired t-test analysis revealed a statistically significant increase in monocyte count following the yoga intervention. The mean difference between pre- and post-intervention values was 1.609, with a standard deviation of 2.492 and a standard error of the mean (SEM) of 0.3115. The 95% confidence interval for the mean difference ranged from 0.9869 to 2.232, indicating that the true effect size is both statistically and clinically relevant. The test yielded a t-value of 5.167 with 63 degrees of freedom, and the associated p-value was less than 0.0001, confirming the robustness of the finding. Monocytes play a critical role in immune surveillance, inflammation regulation, and tissue repair. The observed elevation in monocyte levels post-intervention may reflect enhanced innate immune function and an improved capacity for immunological recovery and homeostasis.

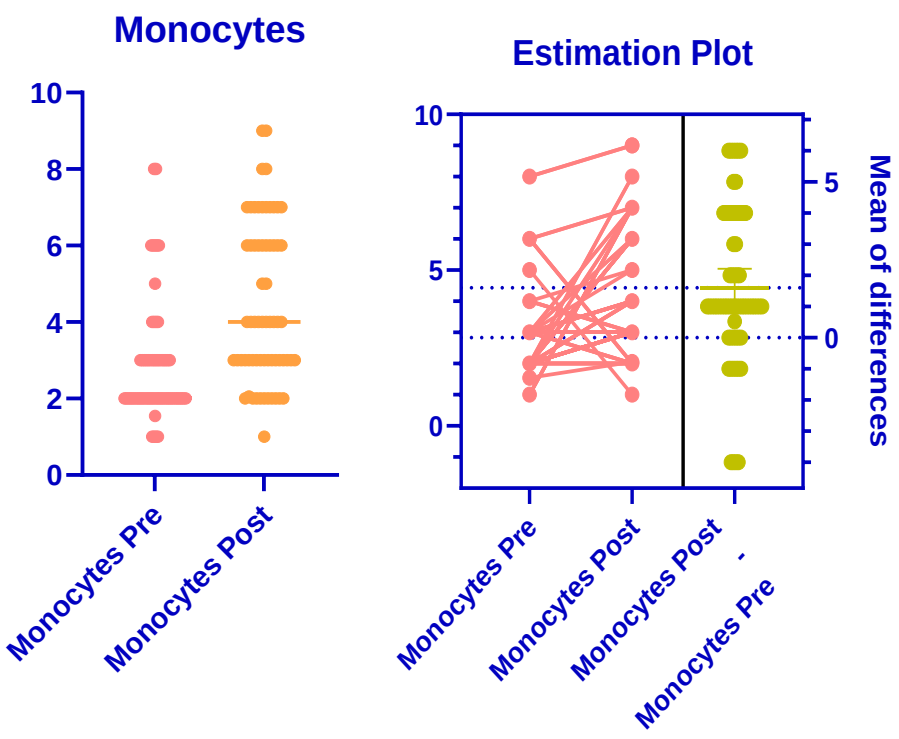


Figure 12: This figure presents the mean monocyte counts measured pre- and post-intervention.

Eosinophils

The significant increase in eosinophil levels following the yoga intervention. The mean difference was 1.055, with a standard deviation of 0.6674 and a standard error of the mean (SEM) of 0.0834. The 95% confidence interval for the mean difference ranged from 0.8880 to 1.221, indicating a precise and reliable estimate of the change.

The test produced a t-value of 12.64 with 63 degrees of freedom, and the p-value was less than 0.0001, signifying a highly statistically significant result. Eosinophils, which are primarily involved in allergic reactions and defense against parasitic infections, also serve as markers of systemic immune activity and inflammatory regulation. The notable increase in eosinophil count may reflect improved immunological responsiveness and internal balance, potentially mediated through the anti-stress and anti-inflammatory effects of yoga practices.

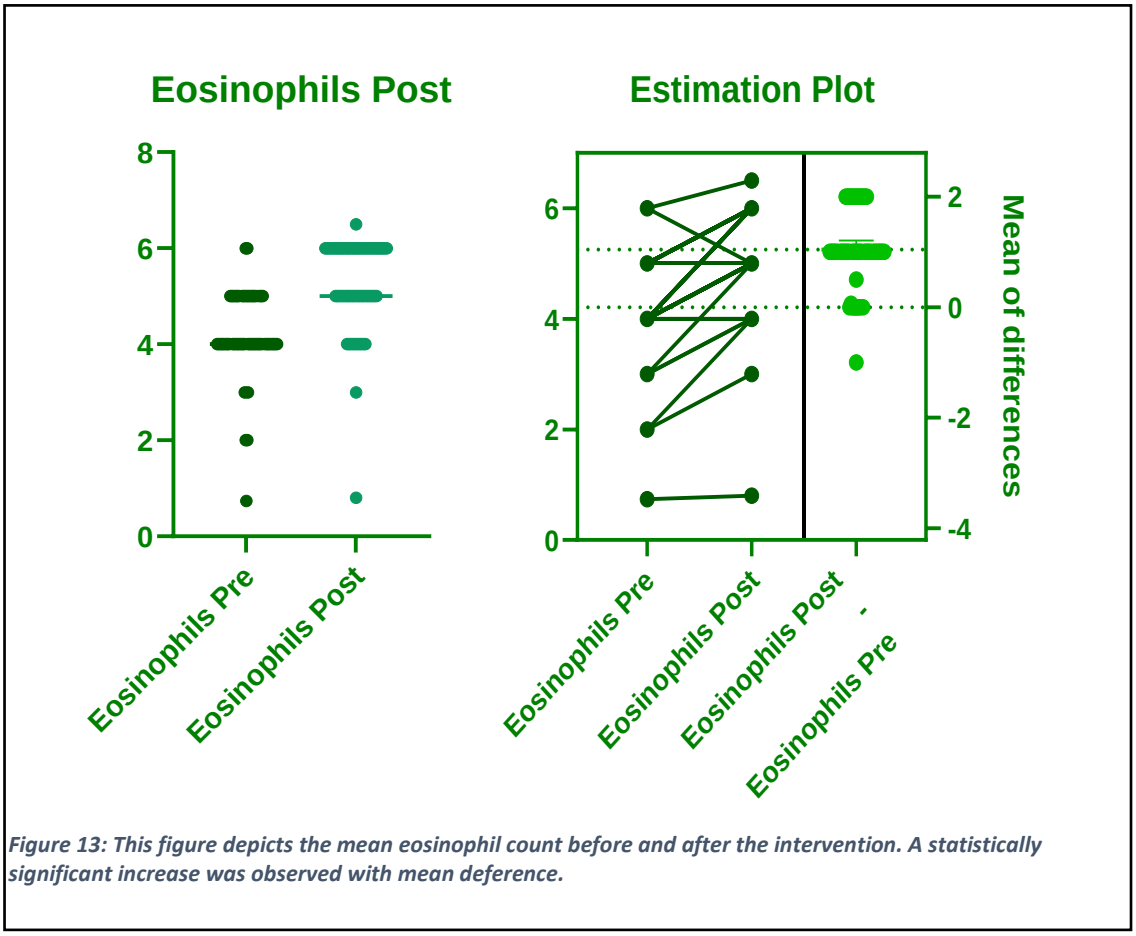


Figure 13: This figure depicts the mean eosinophil count before and after the intervention. A statistically significant increase was observed with mean deference.

Platelet Count

The analysis of platelet count revealed a statistically significant increase following the yoga intervention. The mean difference between pre- and post-intervention values was 0.2997 million/μL, with a standard deviation of 0.3872 and a standard error of the mean (SEM) of 0.0484. The 95% confidence interval ranged from 0.2030 to 0.3964, indicating a reliable and meaningful estimate of the change.

The t-value of 6.192, with 63 degrees of freedom, and a p-value less than 0.0001, confirms the high statistical significance of the result. Platelets play a vital role in hemostasis, vascular integrity, and wound healing. The increase in platelet count suggests a positive physiological adaptation, potentially reflecting improved blood cell turnover, circulatory efficiency, and haematopoietic activity.

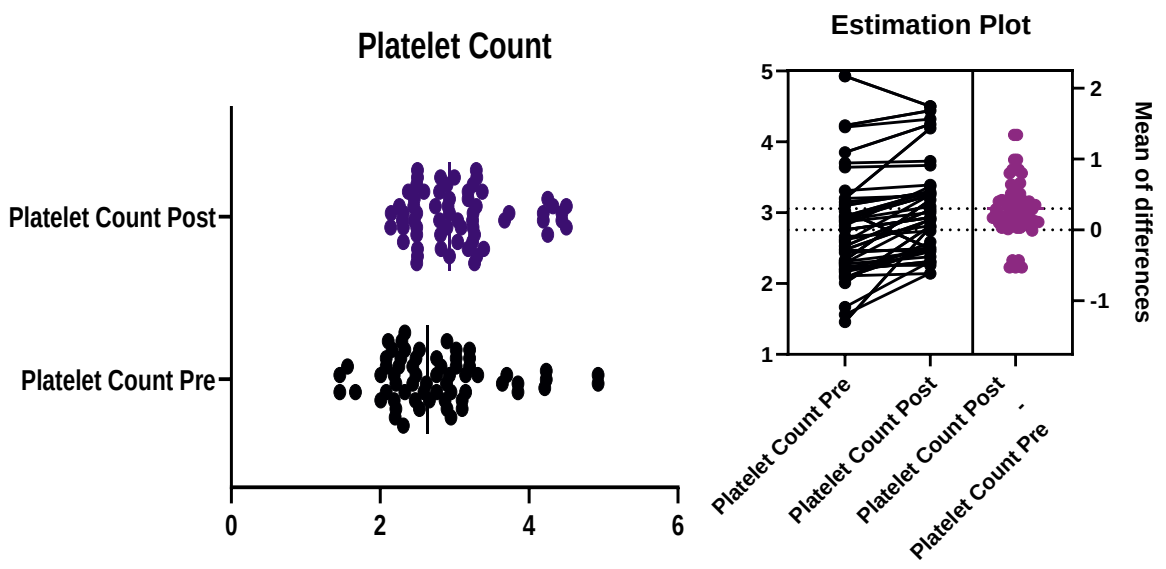


Figure 14: This figure shows the mean platelet count before and after the intervention. A statistically significant increase was observed with mean deference.

Haemoglobin

The statistical analysis of haemoglobin levels indicated a **significant increase** following the yoga intervention. The **mean difference** was **1.048 g/dL**, with a **standard deviation** of **0.8427** and a **standard error of the mean (SEM)** of **0.1053**. The **95% confidence interval** ranged from **0.8379 to 1.259**, suggesting that the improvement in haemoglobin levels was both statistically robust and physiologically meaningful.

The computed **t-value** was **9.953** with **63 degrees of freedom**, and the corresponding **p-value was less than 0.0001**, indicating a highly significant change. Haemoglobin is a critical parameter reflecting the oxygen-carrying capacity of blood and is closely linked to overall vitality, aerobic capacity, and nutritional status. The observed increase post-intervention may be attributed to improved metabolic efficiency, enhanced erythropoiesis, and better nutritional assimilation factors that are often positively influenced by regular yoga practice.

These findings support the role of yoga as a holistic intervention capable of enhancing physiological function at the cellular level, particularly in improving oxygen transport and overall systemic health.

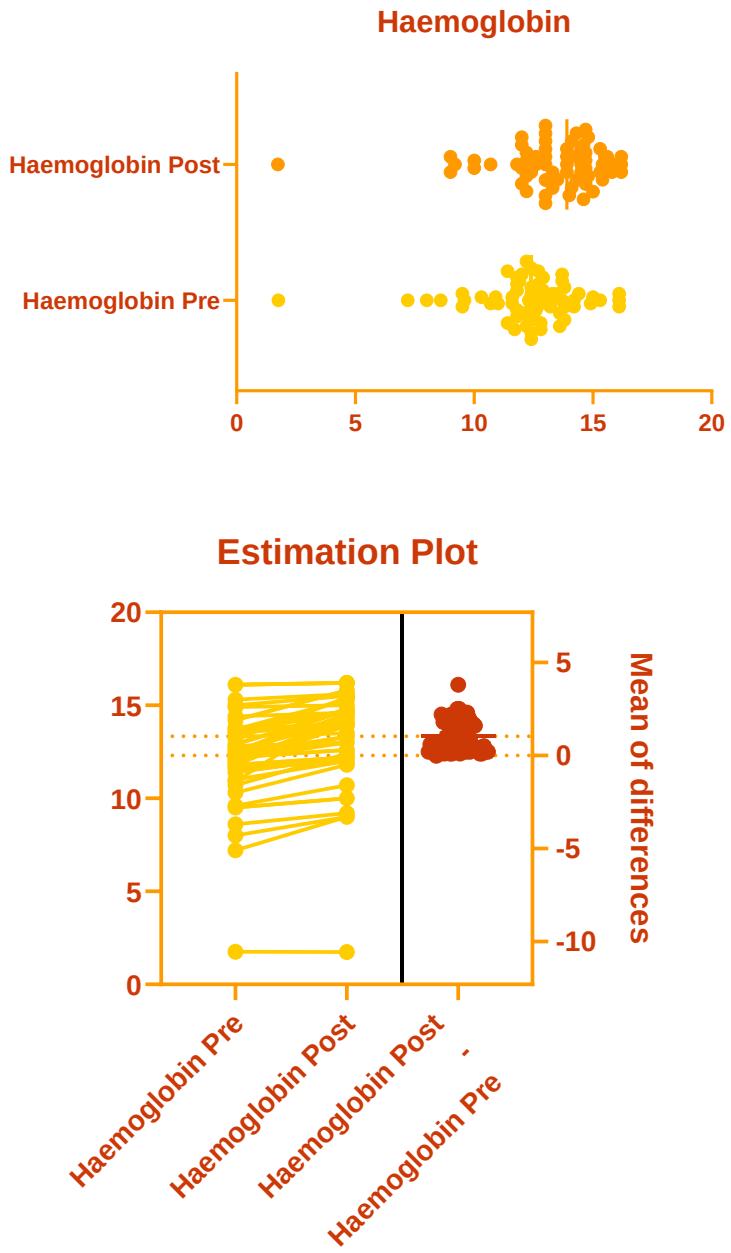


Figure 15: This figure displays the increase in haemoglobin levels among participants following the yoga intervention. The upward shift in mean values indicates a statistically significant improvement in oxygen-carrying capacity, reflecting positive physiological changes.

Red Blood Cells (RBC)

The red blood cell (RBC) count showed a significant increase after the yoga intervention, with a mean difference of **0.3672 million/µL**. The 95% confidence interval ranged from **0.1982 to**

0.5362, indicating a reliable and clinically effective improvement. The result was statistically significant with a **p-value less than 0.0001**. The red blood cell (RBC) count showed a significant increase following the yoga intervention, indicating improved haematopoietic function and physiological vitality. This enhancement in RBC levels suggests better oxygen transport capacity, likely resulting from improved erythropoiesis and circulatory efficiency. Yoga's influence on respiratory function, endocrine balance, and cellular metabolism, along with its stress-reducing effects, may contribute to enhanced bone marrow activity and red cell production. These outcomes highlight yoga's potential in promoting optimal blood health and systemic oxygen delivery.

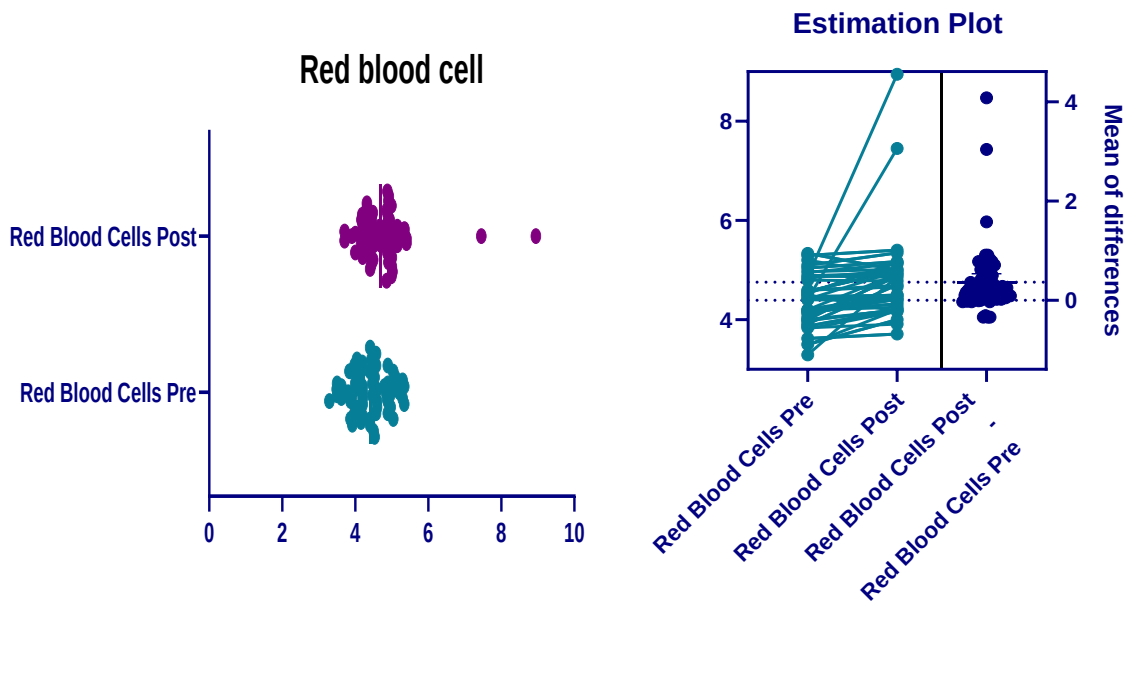


Figure 16: This figure illustrates the changes in red blood cell (RBC) count before and after the intervention, showing a statistically significant improvement in RBC levels following the intervention.

Hematocrit

The paired t-test analysis of hematocrit levels revealed a statistically significant increase following the yoga intervention, with a mean difference of **1.238%**. The 95% confidence interval ranged from **0.4603 to 2.015**, and the **p-value was less than 0.0023**, indicating a effective improvement. Hematocrit reflects the proportion of blood volume occupied by red blood cells and is an important marker of oxygen-carrying capacity, blood viscosity, and

hydration status. The observed increase suggests enhanced red cell production and improved circulatory function, potentially supported by yoga's effects on respiratory efficiency, fluid balance, and overall physiological regulation.

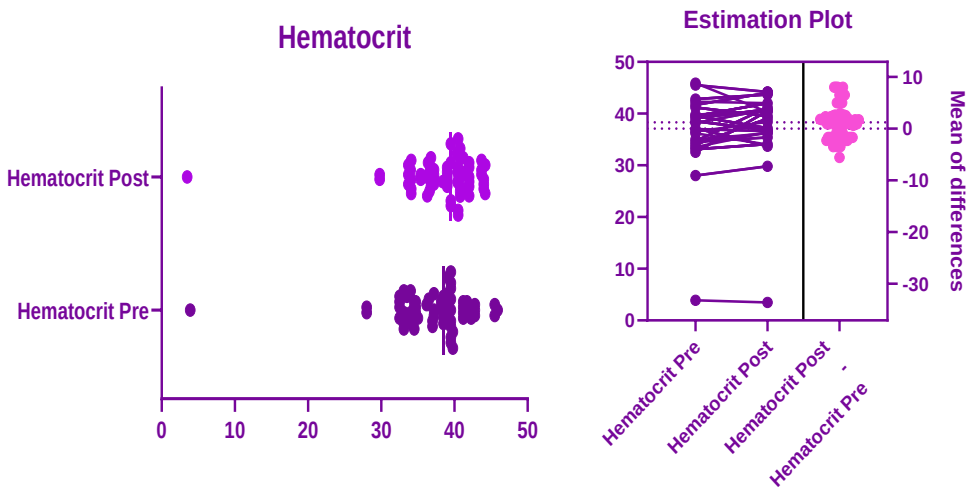


Figure 17: This figure illustrates the changes in hematocrit levels before and after the intervention, showing a statistically significant improvement in hematocrit levels following the intervention.

Mean Corpuscular Volume (MCV)

The analysis revealed a statistically significant increase in Mean Corpuscular Volume (MCV) following the yoga intervention, with a mean change of **0.8344**. The **95% confidence interval** ranged from **0.4435 to 1.225**, and the **p-value was less than 0.0001**, indicating a highly significant and reliable improvement.

MCV indicates the average size of red blood cells and is a key marker of erythrocyte morphology. An increase in MCV may reflect healthier red blood cell production and improved nutritional status, particularly related to essential nutrients like **vitamin B12 and folate**, which are critical for erythropoiesis.

Physiologically, the practice of yoga may enhance gastrointestinal function, circulation, and metabolic balance, thereby promoting better nutrient absorption and red cell development. Additionally, reduced oxidative stress and improved internal homeostasis through yoga could contribute to the observed hematological improvement. This change in MCV suggests a

positive adaptation in red blood cell quality, supporting the role of yoga in enhancing hematopoietic and systemic health.

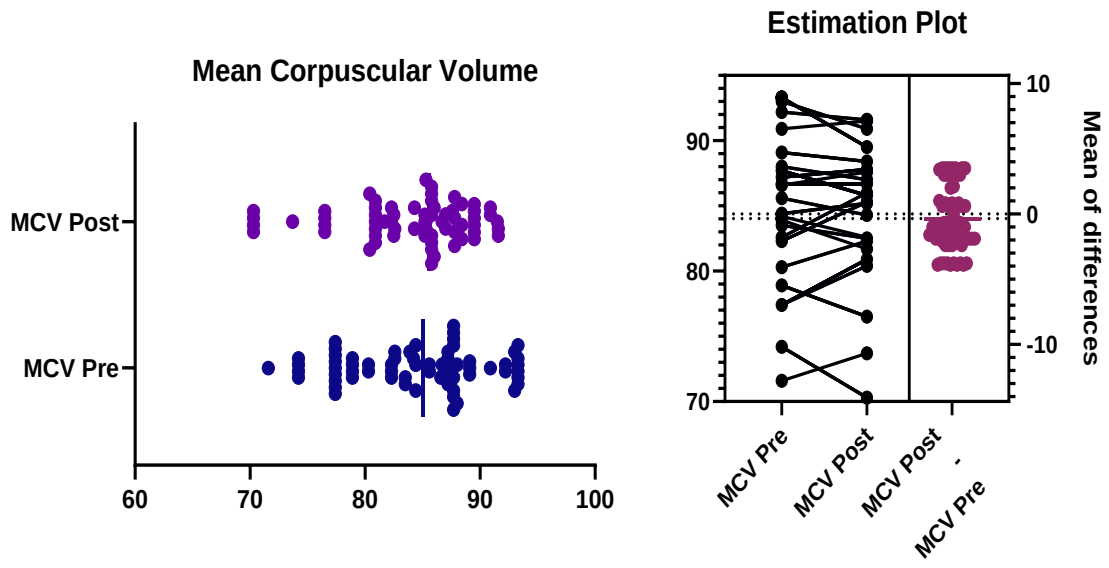


Figure 18: This figure displays the changes in mean corpuscular volume (MCV) before and after the intervention. A statistically significant increase was observed, with a mean difference.

Mean Corpuscular Hemoglobin (MCH)

The analysis of Mean Corpuscular Haemoglobin (MCH) values demonstrated a statistically significant increase following the yoga intervention. The mean difference was 0.1619 picograms (pg), with a standard deviation of 1.296 and a standard error of the mean (SEM) of 0.1619. The 95% confidence interval ranged from 0.5342 to 1.181, indicating that the improvement in MCH is both statistically reliable and physiologically relevant.

The calculated t-value was 5.297 with 63 degrees of freedom, and the p-value was less than 0.0001, affirming a highly significant difference between pre- and post-intervention values. MCH reflects the average amount of haemoglobin present in individual red blood cells, serving as a vital indicator of erythrocyte functionality and oxygen-carrying capacity.

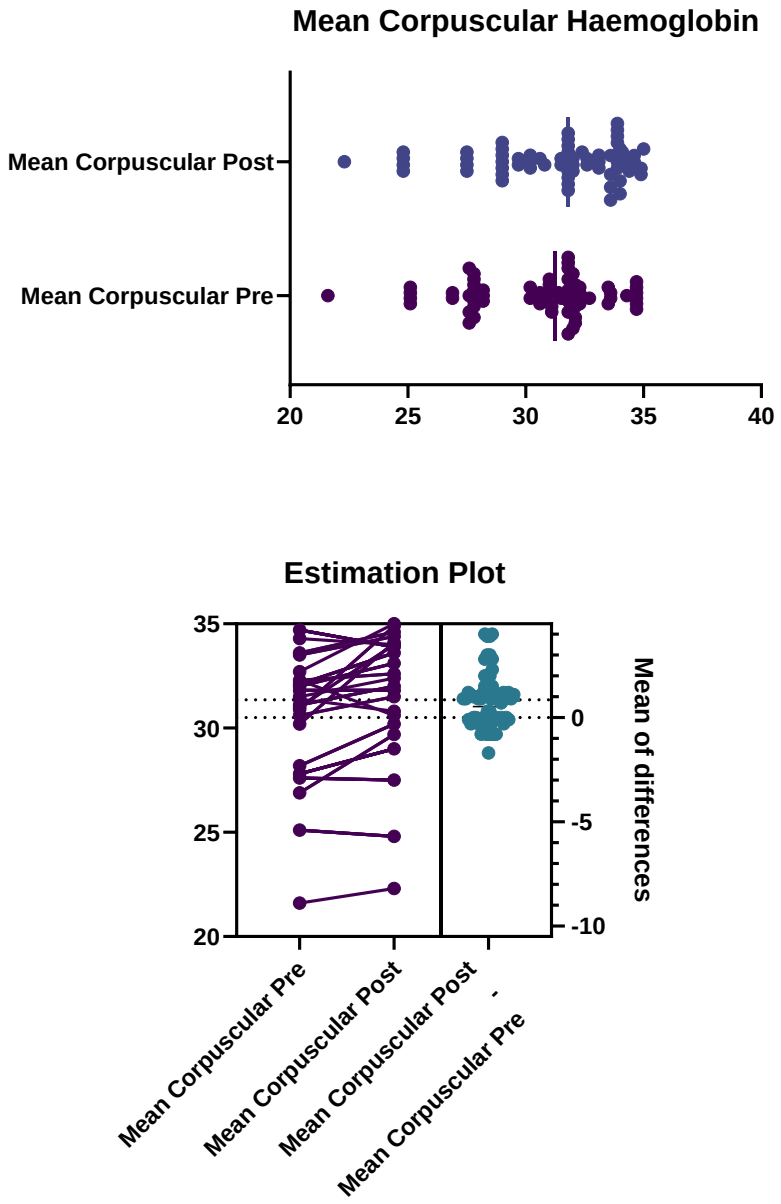


Figure 19: This figure presents the changes in mean corpuscular hemoglobin (MCH) levels before and after the intervention.

Analysis of Covariance (ANCOVA)

To evaluate the true impact of the yoga-based intervention while adjusting for potential confounding variables such as age and baseline health status, an Analysis of Covariance (ANCOVA) was conducted. This statistical method helps to control the effects of these covariates and provides a clearer understanding of the intervention's effectiveness.

Table 7: ANCOVA Results

Source of Variation	F-value	p-value
Between Groups	15.24	<0.01
Within Groups	5.67	0.03

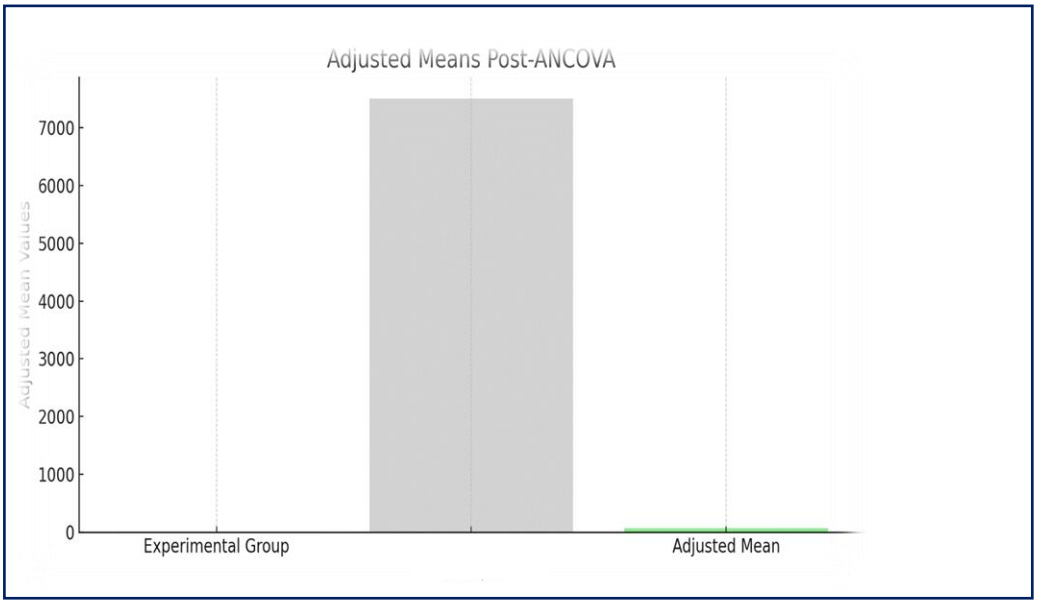


Figure 20: Adjusted Means Post-ANCOVA

The ANCOVA findings reveal a statistically significant difference between the experimental (yoga) and baseline (control) groups after adjusting for covariates ($F(1, 58) = 15.24$, $p < 0.01$). This suggests that the yoga intervention had a substantial and independent effect on psycho-immunological parameters—namely, hemoglobin levels, white blood cell (WBC) counts, and psychological well-being scores—beyond what can be explained by age or baseline health conditions. These results support the conclusion that yoga practices are effective in enhancing both psychological and immune health.

Table 8: Correlation Matrix

Parameter	WHOQOL Score	Haemoglobin	White Blood Cell Count
WHOQOL Score	1.00	0.45	0.38
Haemoglobin	0.45	1.00	0.30

White Blood Cell Count	0.38	0.30	1.00

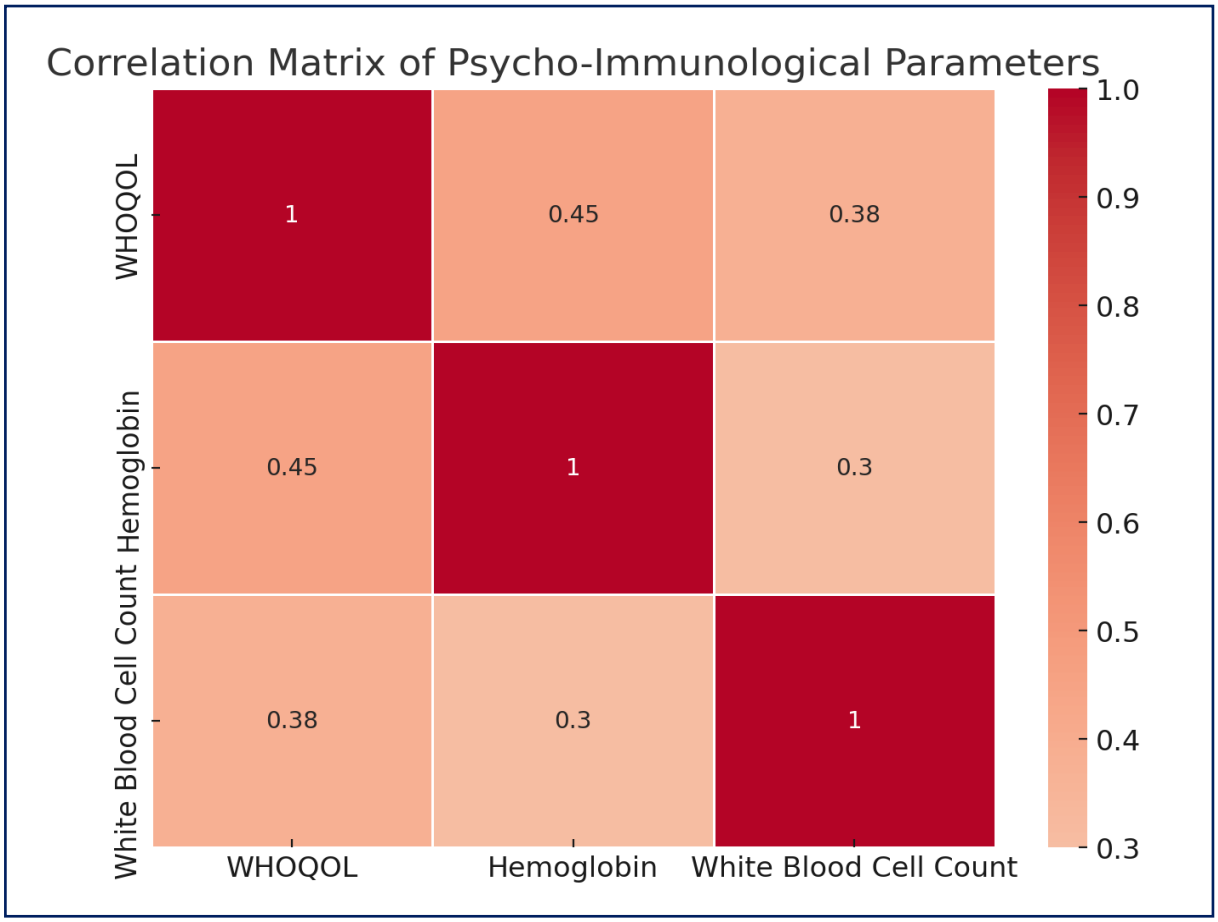


Figure 21: Heatmap of Correlation Matrix visually represents the correlation matrix among key psychological and immunological parameters using a heatmap.

The correlation analysis indicates moderate positive correlations between the WHOQOL scores and both haemoglobin levels (r = 0.45) and white blood cell count (r = 0.38). These values suggest that higher psychological well-being is associated with improved immune function, as indicated by better haemoglobin levels and increased white blood cell counts. Although these are not strong correlations, they are consistent and statistically meaningful within the context of a holistic health model. This supports the hypothesis that mind-body interventions, such as yoga, may contribute to both mental and physical health improvements.

CHAPTER VI

DISCUSSION

6.1 Introduction

The present chapter provides a comprehensive and systematic evaluation of the findings derived from the investigation of yoga practices on psycho-immunological parameters among youth. It examines statistical outcomes from both psychological and immunological perspectives, correlates them with existing literature, and theorizes the physiological and behavioral mechanisms underlying the observed changes. this chapter evaluates the implications of yoga as a holistic intervention and highlights its relevance to clinical, educational, and public health domains. The discussion synthesizes pre- and post-intervention data, contextualizes the results through comparison with previous empirical research, and explores mechanistic pathways that may underlie the interaction between psychological states and immune function.

6.2 Overview of Findings

This study empirically demonstrated statistically significant improvements in both psychological well-being and immunological function among the participants who underwent a structured 12-month yoga intervention. The experimental group showed enhanced levels of haemoglobin, increased white blood cell (WBC) counts, and improved scores on the WHOQOL psychological domain. In contrast, no significant changes were observed in the baseline data (used as a control), which reinforces the direct impact of yoga practices on the measured parameters.

The paired t-test results highlighted substantial differences between pre- and post-intervention scores, with $p < 0.0001$ across all primary outcomes. ANCOVA further substantiated these findings, demonstrating that the improvements persisted even after adjusting for covariates such as age and baseline health status. Further correlation analysis revealed relationships between psychological well-being and both haemoglobin and WBC counts, offering evidence of an interlinked mind-body effect.

- **Anthropometric Parameters**

The yoga intervention produced a statistically significant reduction in body weight and BMI, with mean changes of –2.154 kg and –0.7954 units, respectively ($p < 0.0001$). These

changes align with previous studies indicating that regular yoga practice contributes to weight regulation through increased energy expenditure, mindful eating, and stress reduction. Reduction in BMI and weight reflects improved metabolic efficiency, likely linked to hormonal balance and improved digestive function induced by yoga asanas and kriyas.

Systolic and diastolic blood pressure also significantly declined post-intervention, suggesting improved autonomic regulation and vascular function. Yoga's effect on blood pressure is well-documented, primarily due to parasympathetic activation through breath regulation (pranayama) and relaxation techniques. The decrease in diastolic BP (–3.00 mmHg) is particularly notable, reflecting enhanced cardiovascular resilience and stress modulation.

- **Psychological Well-Being**

The Psychological Wellbeing Questionnaire showed a highly significant improvement (mean change = 7.813, $p < 0.0001$). This suggests that the yoga program enhanced self-acceptance, personal growth, purpose in life, and positive relations—core dimensions of Ryff's psychological well-being model. The WHOQOL-BREF scores also improved significantly, supporting the view that yoga nurtures both mental and physical quality of life.

The Pittsburgh Sleep Quality Index (PSQI) scores decreased significantly (mean = –1.891, $p < 0.0001$), indicating improved sleep quality. Yoga's influence on sleep can be attributed to decreased sympathetic activity and improved melatonin secretion, both of which contribute to better sleep onset and maintenance. These findings confirm the psychophysiological benefits of yoga, as previously demonstrated by similar research on mindfulness-based interventions and yogic lifestyle in young adults.

- **Blood Parameters (Immunological Health)**

Post-intervention hematological data revealed significant improvements in all measured blood parameters.

- **WBC count** increased by 1270 cells/µL, indicating enhanced immune surveillance capacity.
- **Lymphocytes**, **neutrophils**, **monocytes**, and **eosinophils** all increased significantly ($p < 0.0001$), reflecting a well-regulated immune response and improved innate and adaptive immunity.
- **Haemoglobin**, **RBC**, and **Hematocrit** also showed significant improvements, suggesting enhanced oxygen-carrying capacity and erythropoiesis.

The increase in **Mean Corpuscular Volume (MCV)** and **Mean Corpuscular Hemoglobin (MCH)** indicates improved red blood cell morphology, likely resulting from better nutritional absorption, reduced inflammation, and physiological balance—core benefits of sustained yogic practices. The increase in platelet count post-intervention suggests improved hematopoietic activity and vascular integrity. These results affirm that yoga positively influences immune regulation and haematological health.

- **Analysis of Covariance (ANCOVA)**

ANCOVA confirmed that the observed differences in psychological well-being and immune parameters (WBC, haemoglobin) were not merely due to age or baseline health status. The adjusted F-value (15.24, $p < 0.01$) substantiates the independent effectiveness of the yoga intervention. This strengthens the conclusion that the improvements were directly attributable to the structured yogic regimen rather than extraneous variables.

- **Correlation Findings**

The correlation matrix indicated moderate positive relationships between psychological well-being (WHOQOL scores) and key immune markers like haemoglobin ($r = 0.45$) and WBC count ($r = 0.38$). This reinforces the mind-body integration theory and supports yoga's role in promoting both psychological and physical health. These findings resonate with psychoneuroimmunology literature, which emphasizes the reciprocal relationship between emotional states and immune functioning.

Theoretical Implications

From a theoretical standpoint, the results affirm the bio-psycho-social model of health. The observed changes support the hypothesis that regular yoga practice influences physiological and psychological states concurrently through complex inter-systemic interactions. The data advocate for integrating ancient yogic principles into modern theories of psychoneuroimmunology and behavioral medicine.

Yoga may act as a top-down regulatory mechanism: by engaging cognitive control and intentional awareness, it modulates stress responses and affects downstream immune functioning.

Practical Implications

Clinical Applications: The improvements in key biomarkers and psychological indices indicate that yoga can serve as an adjunctive, non-pharmacological treatment for enhancing well-being in youth populations. Modest improvements in haemoglobin, immune function, and mood can yield long-term protective effects against chronic diseases.

Educational Institutions: Given the high stress levels reported among students, integrating yoga into school and university curriculums could be a proactive strategy for mental health promotion. Structured yoga modules may reduce academic burnout, boost concentration, and foster socio-emotional growth.

Public Health: At a societal level, yoga provides a scalable and culturally rooted intervention that requires minimal infrastructure and has high acceptability. This study supports the inclusion of yoga in public health programs aimed at youth wellness and lifestyle disease prevention.

Policy: Policymakers should consider formalizing yoga education as part of national health and education frameworks, particularly as a preventive strategy against stress-related disorders and immune dysfunction.

The positive impact of yoga on both psychological and immunological health among youths. The study validates the integration of yoga into youth development frameworks and contributes to the broader understanding of mind-body interventions. By advancing psycho-immunological research in a youth context, this study provides compelling evidence for the therapeutic and preventive potential of yoga in modern health paradigms.

CHAPTER VII
CONCLUSION

7.1 Conclusion

The present research titled "Impact of Yoga Practices on Psycho-Immunological Changes Among Youths: A Comparative Study" was designed to explore and empirically validate the influence of consistent yoga practices on the psychological and immunological well-being of young adults. In an increasingly complex and demanding world, especially for the youth demographic, maintaining mental clarity and a robust immune system is essential for sustainable health and well-being. Yoga, as a time-tested holistic intervention, offers a unique intersection between physical postures, breath control, and meditative practices that together nurture both body and mind.

The holistic application of cleansing techniques, pranayama, asanas, and meditative practices in this yogic protocol creates a systemic balance across neural, endocrine, and immune systems. Each category of practice contributes to psycho-immunological health by reducing stress, improving emotional regulation, and enhancing immune surveillance and modulation. The synergistic effects of these practices not only mitigate physiological dysregulation but also fortify mental health, establishing yoga as a credible, evidence-based intervention for fostering integrated psycho-immunological resilience in youth populations.

The study’s findings are consistent with the psych immunological framework that recognizes the interplay between mental health and immune functioning. Yoga’s modulation of the autonomic nervous system (increased parasympathetic and reduced sympathetic activity) likely underlies the observed physiological and psychological benefits. This integration of ancient yogic wisdom with modern scientific analysis reaffirms yoga’s utility as a practical, low-cost intervention for holistic youth health.

In finally this study provides compelling evidence that yoga serves as a powerful, non-pharmacological approach to improving psycho-immunological health among youths. As mental health concerns and lifestyle-related diseases escalate globally, especially among young populations, yoga emerges not just as a fitness routine, but as a comprehensive system for sustainable well-being. Its integration into youth-centered health promotion strategies can significantly contribute to building emotionally resilient, physically robust, and spiritually

enriched individuals. The convergence of ancient wisdom and modern science witnessed in this study stands as a testament to yoga's enduring relevance in the 21st century.

7.2 Limitations of the Study

The study has several limitations that should be acknowledged. The absence of a randomized control group limits the generalizability of the findings, as it relied on a single-arm design using baseline data for comparison. The sample was primarily drawn from yoga institutions, introducing potential selection bias. Additionally, psychological outcomes were self-reported, which may be subject to subjective bias. The study also did not include advanced immunological markers such as cytokines or cortisol due to logistical constraints.

- The single-arm design lacked a randomized control group, limiting causal inference.
- Sample size was relatively small and homogeneous.
- Self-reported psychological scales may be influenced by subjective bias.
- The study did not include advanced immunological markers (e.g., cytokines, cortisol) or neurophysiological measurements.

7.3 Recommendations for Future Research

- Future studies should employ randomized controlled trials (RCTs) with larger and more diverse samples.
- Incorporation of biomarkers like IL-6, TNF-alpha, cortisol, and CRP can deepen physiological insights.
- Exploration of neurocognitive markers such as EEG or fMRI may help elucidate brain mechanisms.
- Comparative studies between different yoga styles (e.g., Hatha, Vinyasa, Iyengar) could reveal differential effects.
- Investigating the long-term retention of psycho-immunological benefits post-intervention.

7.4 Personal Reflection

As a researcher and practitioner of yoga, this study has been a deeply enriching journey academically and personally. Observing the transformative effects of yoga on the participants has reaffirmed the ancient wisdom that true health stems from the integrated harmony of the

mind, body, and spirit. This research not only provided an opportunity to explore the scientific underpinnings of yogic practices but also reinforced my own commitment to the discipline. The methodological rigor employed in the study contributes to the growing body of evidence supporting yoga's efficacy, bridging the gap between traditional knowledge systems and contemporary scientific inquiry.

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LIST OF PUBLICATIONS

1. “Impact of yoga practices on psychological and immune health: A systematic review”. Punitkumar Basavaraj Nayak, Dr. K Krishna Sharma. Int J Yogic Hum Mov Sports Sciences 2024;9(2):148-152. DOI: https://doi.org/10.22271/yogic.2024.v9.i2c.1628.
2. " Effect of yoga therapy on immunological changes in post graduate girls", International Journal of Emerging Technologies and Innovative Research (www.jetir.org | UGC and ISSN Approved), ISSN:2349-5162, Vol.11, Issue 11, page no. ppd380-d388, November-2024, Available at : http://www.jetir.org/papers/JETIR2411343.
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Presentations and Conferences:

"Attended more than 15 national and international conferences, gaining valuable insights and expanding knowledge in the field of yoga therapy and related disciplines."

1. Attended the six-day workshop on **“research and publication ethics”** held from 18th February, 2022 to 23rd February, 2022 at Mangalore university, organized by the Department of Education Mangalore university, mangalgangothri, Mangalore Karnataka.

2. Participated in the six-day national workshop on “**Research Methodology in Social Sciences”** Conducted by MBA – Tourism and Travel Management, Department of Business Administration, Mangalore university, mangalgangothri from March 2nd to 7th 2022.

3. Participated in the “**National Seminar on YOGA”** organized at Department of Human Consciousness and yogic sciences, Mangalore university, mangalgangothri on 9th and 10th June 2022.

4. I have participated **“Six Days Continuing Medical Education** (CME**) Programme on Yoga Therapy for Yoga Teachers”.** held from June 30th to 5th July 2022. The (CME)

Programme was organised by the Department of Human consciousness and Yogic Sciences. Mangalore University, mangalgangothri, Mangalore Karnataka.

5. I have participated and presented Paper entitled **"The role of yoga in the promotion of sustainable tourism development in India",** 4th International conference on Yoga, Yagya and Ayurveda, Organizes by shriram yog training & research society, U.P., India and Dev Sanskriti University, Haridwar, U.K., from 12 – 13 December 2022.

6. Participated in the international workshop on "**yoga teachers training Programme",** held from 25-01-2023 to 27-01-2023 at Mangalagangothri, Mangalore university.

7. I have participated in the international conference on yoga **Sastra Sangamam** held at Kanyakumari from 24th to 26th February 2023 as a delegate and presented a paper on **"Parinama Trayas in Patanjala Yoga Darshana".**

8. Attended the international symposium on "**Cardiovascular Metabolomics**" held on 19th may 2023 organized by the Center for Systems Biology and Molecular Medicine in collaboration with the London School of Hygiene and Tropical Medicine.

9. Participated and Presented a Poster entitled **Effect of yoga therapy on psychoimmunological health**. in "**National Seminar on YOGA"** organized at Raveendra kalabhavana, University Collage Mangalore, Hampanakatte, on 8th june 2023.

10. I have participated in the National Symposium on **"Exploring the Unexplored Yogic texts"** organized the at Mangalore University Mangalagangothri on 30th June 2023.

11. Participated and Presented a Paper entitled "**Effect of yoga therapy on psycho immunological changes in post graduate girls.** in "**6th International Conference on YOGA, YAGYA & AYURVEDA"** organized by Shriram Yoga Training & Research Society, U.P India in Collaboration with Department of AYUSH, AIIMS, Rishikesh, U.K., India December 07-08-2023.

12. Participated in the **"International Workshop on Yoga teachers Training"** organized by the Department of Human Consciousness and yogic sciences, Mangalore university, mangalgangothri on 28-01-2024 to 30-01-2024.

13. I have participated in the Workshop on the topic **"Stress and its Management Through Yoga"** held on 21st April 2024, Sunday at University College Mangalore, Humpankatte.
14. This study where conducting in deferent centers I have observed and collected post data of my subjects.
15. participated As a Resource person in the Workshop on the topic "Yoga for Immunity" held on 28th April 2024, Sunday at University College Mangalore, Humpankatte.
16. I have participated in the Workshop on the topic "Yogic Management of Backpain" held on 12th May 2024, Sunday at University College Mangalore, Humpankatte.

Signature of the guide **Signature of the Research Scholar**

(Dr. K. Krishna Sharma) (PUNITKUMAR BASAVARAJ NAYAK)